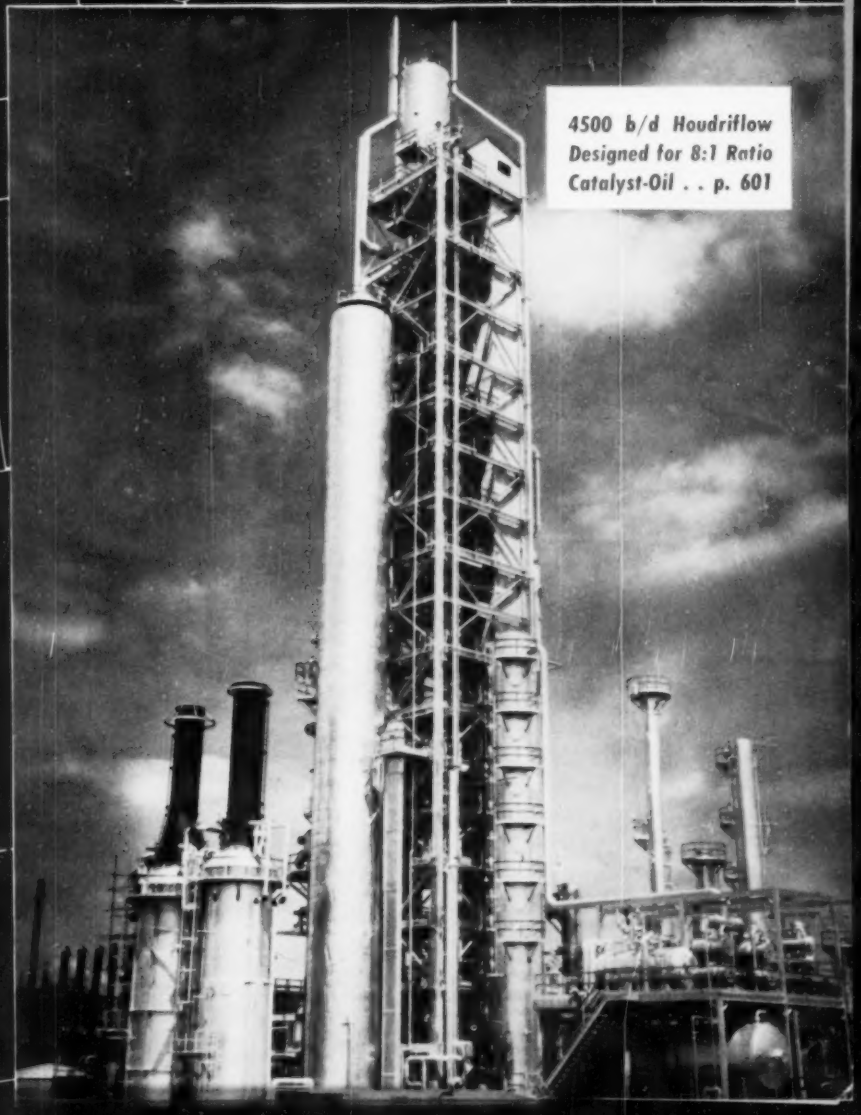
JUNE, 1950
VOL. 5, NO. 6

PETROLEUM PROCESSING



4500 b/d Houdriflow Designed for 8:1 Ratio Catalyst-Oil . . p. 601

13 in 49

THE *Seeligson Plant*

pictured below, is the largest of 13 gas processing plants completed by HUDSON and placed in operation during 1949. The experience and pride in workmanship which went into the design and building of these 13 projects is evidenced in the complete satisfaction of their Owners and Operators.

From Colorado to Alabama and abroad, at elevations from sea level to a mile, at atmospheric temperatures of minus 40° F to plus 110° F, under process pressures from high vacuum to 8000 pounds per square inch, HUDSON plants have built the HUDSON reputation for dependability and performance.

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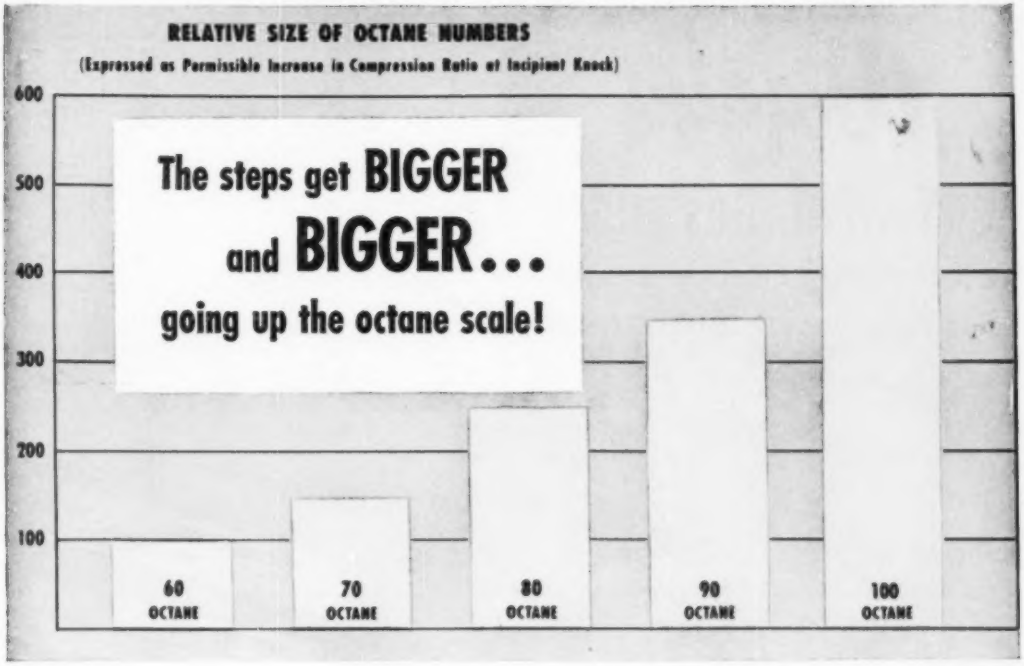


THE Octane Scale is a useful tool for the control of gasoline quality. However, it does not give a complete indication of what fuels can deliver in an engine.

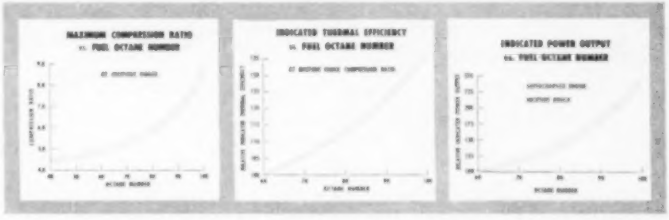
On the Octane Scale one unit appears to be equal in size to every other unit. But in terms of actual engine performance, octane units at different levels vary greatly in size.

For example, expressed as *permissible increase in compression ratio* (bar chart above), one octane unit at the 90 level is 3.5 times as large as at the 60 level. At the 100 octane level, a unit is 6 times as large as at the 60 level. In other words, the steps up the octane scale get larger and larger.

Complete evaluation of the quality of gasoline requires measurement not only in terms of octane numbers but also in terms of scales based on those factors of engine performance dependent on antiknock quality. Three such factors are permissible compression ratio, thermal efficiency and power output. The three charts below show the relation between octane number and these engine factors.

Each chart shows that in terms of potential engine performance, octane numbers get "bigger" and more valuable going up the scale.

When reviewing the economics of gasoline production, refiners might profitably think not solely in terms of octane numbers but in terms of scales of antiknock quality based on the three factors of engine performance—maximum permissible compression ratio, thermal efficiency, and maximum power obtainable.



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[To obtain more data on advertised products see page 666]

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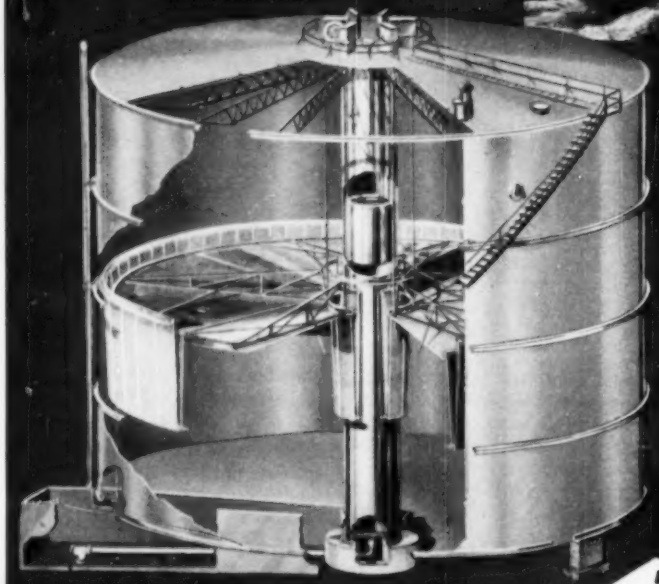
COVERS BREATHING AND PUMPING LOSS INTO PROFITS



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UNDER COVER

EASY ACCESS FOR INSPECTION
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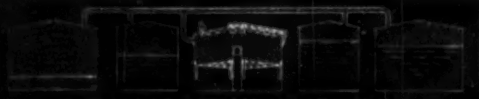

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A daily independent oil-news reporting service issued from New York, Cleveland, Houston

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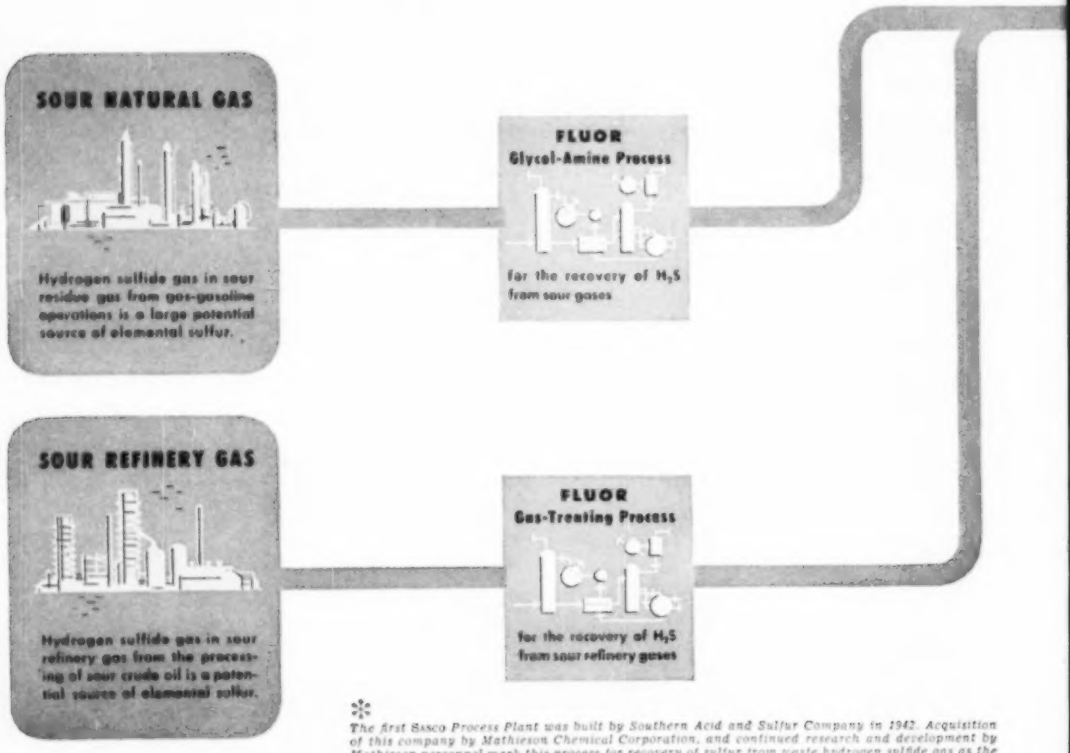
SULFUR ...FROM SOUR

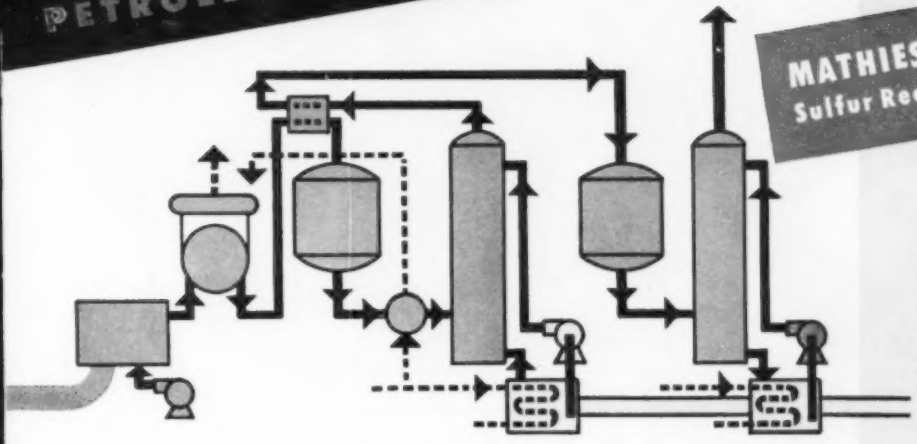
Now, for the first time, the Mathieson *Sasco Process for the commercial recovery of elemental sulfur from waste hydrogen sulfide gas is available to operators of petroleum refineries and natural gasoline plants. An agreement between The Fluor Corporation, Ltd., and Mathieson Chemical Corporation designates Fluor as the sole licensing agent for the engineering and construction of sulfur recovery plants incorporating Mathieson's Sasco Process. All details, including first studies, are available through Fluor.


SOUR NATURAL GAS
Hydrogen sulfide gas in sour residue gas from gas-gasoline operations is a large potential source of elemental sulfur.
FLUOR
Glycol-Amine Process
for the recovery of H_2S from sour gases
SOUR REFINERY GAS
Hydrogen sulfide gas in sour refinery gas from the processing of sour crude oil is a potential source of elemental sulfur.
FLUOR
Gas-Treating Process
for the recovery of H_2S from sour refinery gases

The first Sasco Process Plant was built by Southern Acid and Sulfur Company in 1942. Acquisition of this company by Mathieson Chemical Corporation, and continued research and development by Mathieson personnel mark this process for recovery of sulfur from waste hydrogen sulfide gas as the only one developed in the United States with a record of several years' successful operation.

RECOVERY
PETROLEUM GASES

MATHIESON-SASCO
Sulfur Recovery Process



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A gas stream containing hydrogen sulfide gas, such as the acid gas effluent from an amine plant, is partially burned with air—the heat being utilized for steam production. The combustion gases are passed through a catalyst where SO_2 and H_2S react to form sulfur and water vapor. Elemental sulfur is then recovered from the gas stream by contacting with liquid sulfur in wash towers. The residue gas containing nitrogen, carbon dioxide and water vapor is vented to the atmosphere.

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This proven Sasco Process for the profitable recovery of elemental sulfur from waste hydrogen sulfide gas is available under *one* contract, *one* responsibility through The Fluor Corporation, Ltd. As designers, engineers, and constructors for the petroleum industry since 1890, Fluor possesses the background, the know-how and the experience essential for the interpretation of Mathieson's Sasco Process into *your* particular sulfur recovery program. Prior to contract negotiations, Fluor will make economic studies covering every phase of proposed sulfur recovery installations—location of potential and ready markets, initial investment, operating costs, and profits to the investor.

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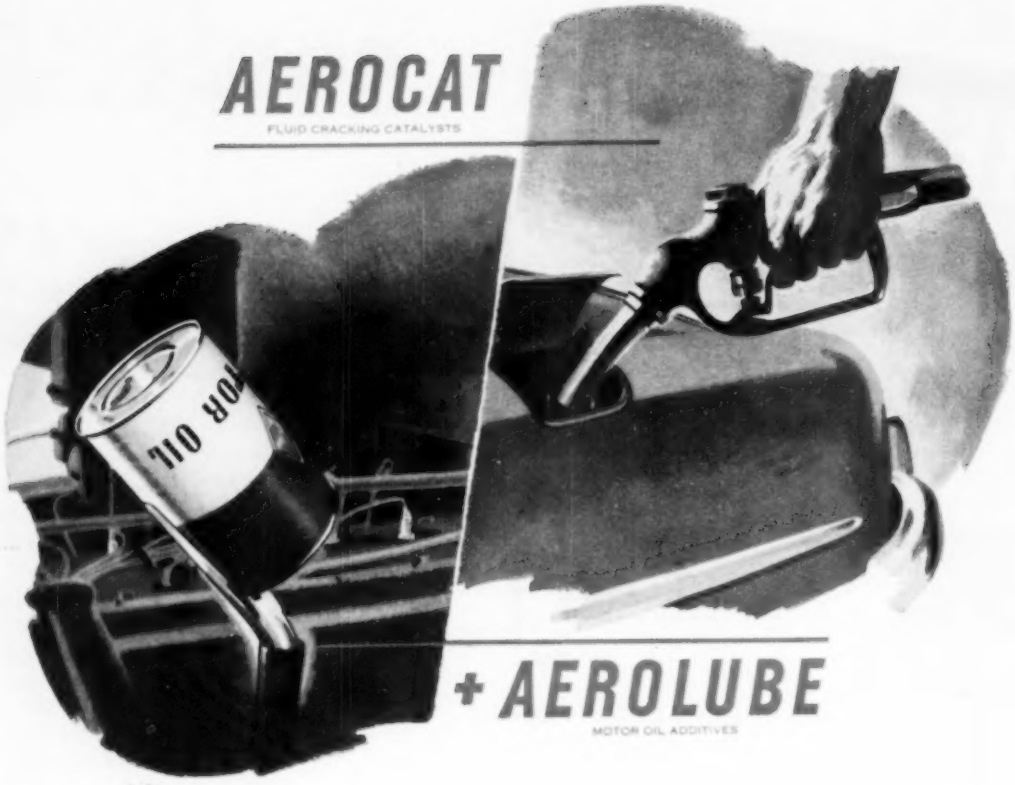

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WHEN PERFORMANCE COUNTS . . . CALL ON CYANAMID

[To obtain more data on advertised products see page 666]

What's Happening!

Important Current News Summarized for Refiners

EXPANSION

McColl-Frontenac Oil Co. Ltd. has awarded contract to Foster Wheeler Ltd., for design and construction of its new $10,000,000 refinery at Edmonton, Alberta. Plant, with total crude capacity of 5,525 b/d, will have catalytic cracking facilities. Work has already commenced, with completion scheduled for next year.

Shallow Water Refining Co., Garden City, Kans., is now drawing up plans for a new polymerization unit, on which construction is expected to start Sept. 1. Company recently completed a 1,250 b/d Perco reforming unit at its plant.

Phillips Petroleum Co. will build a 30,000 b/d catalytic cracking unit at its Phillips, Texas, refinery to increase production of high quality gasoline and distillates, while at the same time reducing residual fuel make. Included in the expansion will also be gas recovery, gasoline and light ends fractionation, and associated facilities. Contract has been awarded to C. F. Braun & Co. Site clearance is under way and work is scheduled for completion by Sept. 15, 1951.

• • •

NATURAL GASOLINE

Sinclair Oil & Gas Co. has purchased a half interest in the former Lisbon Gasoline Co.'s natural gasoline plant at Price, Texas, together with gathering system in the East Texas oil field. Gas throughput capacity is approximately 10,000 Mcfd. and production is 50,000 gal. propane and in excess of 70,000 gal. daily of mixed nautral gasoline and butane. Arkansas Fuel Oil Co. owns remaining half interest; Sinclair will operate facilities.

The South Fullerton gasoline plant, near Andrews, Texas, was opened for inspection May 21. Operated by Stanolind Oil & Gas Co. for the 14 other owners, plant can process 38,000 Mcfd. of gas, producing 80,000 gal. propane, 50,000 gal. butane and 50,000 gal. natural gasoline daily. Processing equipment is sized to handle approximately 55,000 Mcfd. of gas ultimately.

Imperial Oil Co. unveiled its $4,000,000 Leduc Gas Conservation Plant May 12. Located just outside Devon, Alberta, the new plant will have an initial capacity of 17,000 Mcfd., with an ultimate design capacity of 24,000 Mcfd., and will recover natural gasoline, butane and LPG. Construction of the plant, started in June, 1949, was handled by C. F. Braun & Co. of Canada.

• • •

COMPLETIONS

Socony-Vacuum Oil Co. has increased the capacity of its East St. Louis, Ill., refinery from 21,000 b/d to 30,000 b/d with completion last month of an extensive modernization program at the plant. New facilities include a 17,000-bbl. crude distillation tower, and 20,000-bbl. gasoline treater. The company plans to put its wartime HF alkylation unit back into operation later this year.

General Petroleum Corp. has completed the 7500 b/d coker unit and hydrogen sulfide absorber at its Torrance, Calif., refinery. Lummus Co. now has contract for erection there of a catalytic cracker furnace capable of handling 4000 b/d.

Esso Standard Oil Co.'s new MEK solvent dewaxing plant has completed test runs. Unit, of 6000 b/d capacity, was built by E. B. Badger & Sons Co.

• • •

MARKETS, PRICES

An upswing in demand for nearly all petroleum products in May caught the industry with relatively low stocks and refinery operations at only slightly over 80% of capacity. The result was firmer prices over a broad front. Higher prices were quoted in many areas for gasoline, distillate fuels, residuals and lubricating oils. The "climate" was sufficiently attractive to cause at least one of the shutdown Independent refiners at the Gulf (Maritime Oil Co. at Houston) to resume operations.

General price increases were made in a number of cases: The Texas Co. hiked gasoline tank wagon prices 0.5c per gal. throughout Texas, east of the Pecos River, early in May. Standard Oil Co. (Ind.) increased gasoline prices in seven midwestern states

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

May 9 and 10. Continental Oil Co. advanced its tank wagon prices for gasoline 0.5c per gal. in Oklahoma, New Mexico, Colorado and several points in southern Wyoming May 15.

A late spring advance in heating oil prices caught many seaboard secondary buyers off guard. Prices at East Coast terminals were up in amounts ranging from 0.2c to 0.5c per gal. Advances were made by Esso Standard, Socony-Vacuum and Atlantic Refining.

Miscellaneous price highlights: Natural gasoline price trend continued upward in the Mid-Continent. Lubricating oil prices were buoyant after a long period of moving "sidewise"; contrary to industry expectations that enlarged production of solvent oils would result in oversupply, some refiners declared they were sold up on lubes into the fall. Wax was the only exception to the general trend upward in prices.

• • •

FOREIGN

California Texas Oil Co. Ltd. officially opened its new $18,000,000 refinery at Pernis, 8 miles from Rotterdam, Netherlands, on May 12. The new refinery, built entirely from the ground up, adds one million tons to the annual refining capacity of the Dutch petroleum industry, and will operate on American-controlled crude from the Persian Gulf.

Standard Oil Co. (N. J.) will become partner with Italian government and private Italian capital in a new Italian refining corporation, STANIC. Jersey will invest $12,000,000 in venture and acquire half of new firm's capital stock, with other half being owned by the existing Italian company, Azienda Nazaionale Idrogenazione Combustibile (ANIC), in which Italian government owns a substantial interest. Jersey will acquire half interest in ANIC's refineries at Bari and Leghorn.

• • •

PRODUCTS

A third grade of gasoline has been made available by Esso Standard Oil Co. in four states—New Jersey, Virginia, Tennessee, Arkansas—to meet competition of multi-pump cut price stations. The third grade is marketed under the brand name "Standard", and posted tank wagon price at Esso's Linden, N. J., bulk plant is 13.3c per gal., ex taxes—0.9c below regular grade.

Fuel oil consumption by electric power plants during April totaled 5,319,423 bbl.—highest April consumption on record and 35.9% above April, 1949, according to report by Federal Power Commission, released May 31. During same period coal consumption increased 3.4% and gas useage was up 17.5%.

Commercial avgas octane ratings are remaining fairly constant, according to Bureau of Mines annual survey of aviation fuels. Average octane numbers of four grades produced in October, 1949, varied little from those of previous surveys. Free copy of report, RI 4664, "National Annual Survey of Commercial Aviation Gasoline, October 1949 Production," may be obtained from Bureau's Publications Distribution Section, 4800 Forbes St., Pittsburgh 13.

• • •

TRANSITION

Lodi Gasoline plant, near Bivins, Texas, has been purchased by Breckenridge Gasoline Co. from Phillips Petroleum Co. Plant is rated at 30,000 Mcfd. of gas, produces 34,000 gal. daily of natural gasoline.

Producers Refining, Inc., of West Branch, Mich., has purchased the Asphalt Products Co. in that city and will operate the plant as its Asphalt Division.

• • •

MISCELLANY

A new Department of Technical Services has been established by the American Petroleum Institute, to handle four groups of staff services: engineering and research, accident prevention and fire protection, general program and coordination, and API's agricultural program. Director of new group is D. V. Stroop, who previously headed up API's Safety Department, which the new department replaces. Stroop will also continue as assistant to the president of API.

A Chemical Industry Correlating Committee has been organized by the American Standards Assn. to coordinate the views of the chemical industry on standards dealing with equipment and materials the industry uses in construction, maintenance and operation of manufacturing facilities. Its studies are expected to include pipe, pipe fittings and flanges, thin-wall tubing, and pressure vessels.

German wartime patent applications in petroleum and other industrial fields are indexed in the new "Subject Outline of the Unpublished Applications for Patents Filed at the German Patent Office, 1940-45," available free of charge from the Office of Technical Services, Commerce Department, Washington 25. Approximately 200,000 applications are listed.

Canada's production of crude increased nearly 75% last year—from a daily average of 33,792 bbl. in 1948 to 58,869 bbl. in 1949.

Dieselization of American railroads continued at full speed last month. The Boston & Maine Railroad ordered 24 Diesel locomotives, the Baltimore & Ohio 34, and the Nashville, Chattanooga & St. Louis 47.

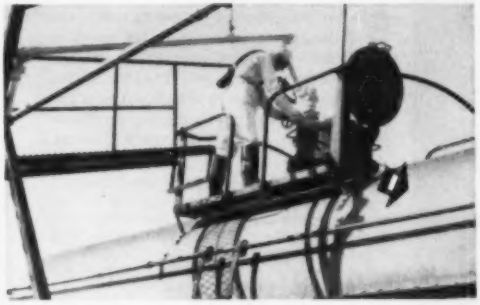
An Idea ... THAT WENT TO WORK!

SHELL OIL ADDS T.E.L. FLUID

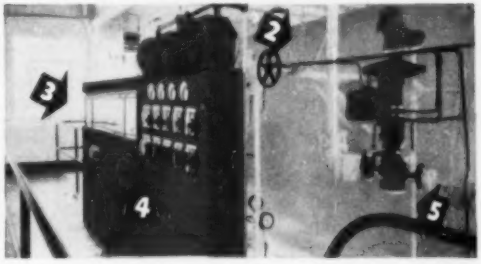
Automatically

AT WOOD RIVER PIPELINE STATION

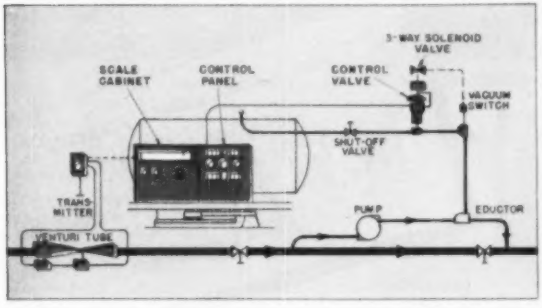
%Proportioneers, Inc.% Loss-In-Weight T.E.L. Blender has proven an economical answer to the problem of supplying leaded gasoline to pipeline facilities. Payout is most attractive when compared with in-tank blending. Each installation is carefully engineered and approved for the specific job requirements. Call in %Proportioneers, Inc.% for engineering advice and equipment.



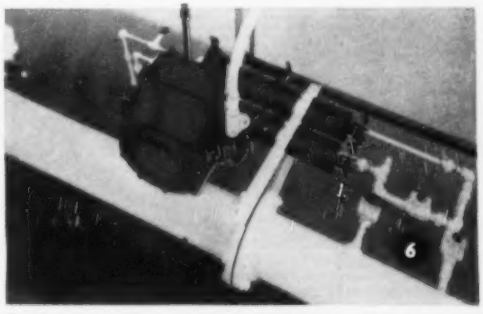
1—T.E.L. Fluid is drawn under vacuum from tank car.



2—Fluid storage tank on standard scale. 3—%Proportioneers, Inc.% Automatic and Flow Responsive Loss-In-Weight Proportioning Scales. 4—Complete alarm panel fully protects system. 5—Specially designed Diaphragm Control Valve for T.E.L. Fluid.



All equipment shown red in photos and flowgram furnished by %Proportioneers, Inc.%



6—Venturi Meter measures gasoline flow through pipeline and maintains uniform pre-set lead treatment.

No. 2 in a series on T.E.L. blending.

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Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

A strange breed of "cat"... cat-equipment, that is!

ONE of the unusual types of equipment Kellogg is frequently called upon to fabricate is the cat-poly reactor. A strange breed of heat exchanger, it is in reality a combination pressure vessel and heat exchanger, inasmuch as operating pressures in the catalyst-packed tubes reach 1200 psi. Another unusual aspect of these exchanger-vessels is that they are designed to be taken out of service regularly for replacement of catalyst, rather than being built to operate without maintenance for as long a period as possible.

Fabrication of this type of equipment is unusual, too, in the heat exchange field. First, it's on the "grand" scale, tubes being 5 inches in diameter and 40 feet long, and the shells 50 inches in diameter. But probably the most important single fabrication step is *the welding of the tubes to the tube sheets*, replacing the customary roll-in operation. Here Kellogg's unusually broad experience in welding techniques asserts its importance... guarantees the customer finished cat-poly reactors in the minimum time with the maximum service life built in.

One recent order!

An even dozen Kellogg cat-poly reactors are installed in this brand new East Coast refinery. Another three-quarter dozen are now being finished in Kellogg shops, destined for a Midwest plant operated by the same refiner.

Continuing Basic Study of the principles of heat exchange conducted by Kellogg development groups for more than twenty years has produced unduplicated design data.

Shop Layout Craftsmen are fully experienced on all types of heat exchanger fabrication from gigantic marine condensers to intricate jet motor combustion-chamber shells.

Extensive Shop Facilities, including every necessary fabricating step from plate rolling to stud threading, permit *complete* fabrication under same roof of any type of heat exchanger for any kind of service.

Special Shop Techniques permit the economical fabrication of the component parts for each heat exchanger as an individual production order and provide every exchanger with the advantages of "tailor-made" fit and serviceability.

Rigid Quality Control maintained by inspectors reporting directly to *Shop Management* rather than to *Production* executives, maintains quality of work at a much higher level than could be attained by customary control methods.

To master temperature, pressure and chemicals use

M. W. KELLOGG

process equipment

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Heat Exchangers
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Vacuum Vessels
Fractionating Columns
Drums and Shells

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Tomorrow
. . . IN PETROLEUM TECHNOLOGY

By B. H. WEIL, Atlanta, Ga.
Editor, "Monthly Summary of Industrial Developments"

Brief Reviews of Current Technological and Economic Developments, Reported in the Light of Their Possible Effect on Future Petroleum Processing Operations

"Solid" Gasoline Stored In Pellets of Algin

GASOLINE, fortunately for our economy, is a liquid fuel, and as such it commands a premium per Btu., based on the benefits derived from ease of transportation and use. There are times, however, when its fluidity temporarily lacks benefits and may even impose disadvantages, and it is then that the possibilities of a comparatively new "solid storage" methods attracts attention.

Some 16 years ago, it seems, a French chemist, Jean Pathus-Labour, accidentally discovered that mixture of a solution of algin with gasoline yielded pellets of algin that contained considerable quantities of gasoline. During the recent war, his process was carried to the pilot-plant stage by the Germans; after the war, Pathus-Labour came to this country and erected a pilot plant for Glenn L. Martin. The U. S. Army Quartermaster Corps acquired a license for this process in June, 1948; patents on it are said to be owned by a Panamanian corporation, the Gasoline Research Industrial and Commercial Co., Inc. The Southwest Research Institute at San Antonio, Texas, is now said to be acting as a clearing house for pilot-plant work and information on the use of this process for solidifying other materials than fuels.

The Carburolith process, as it is called, yields a solidified product, when used with fuels, whose principal advantages are "ease of transportation, the fact that it does not explode but when ignited simply burns and can be easily controlled with water, and its ability to be stored under almost any conditions without appreciable loss. Army interest has been particularly for building up supplies in such areas as Alaska . . . . Recovery of the stored liquid can be accomplished by pressing, distintegration and centrifugation, or other methods, and the efficiency of recovery is over 99%." (1)

The process itself is said to be simple. An emulsion is formed between the liquid to be stored and a water solution of an alginate from brown seaweed. This emulsion is then "passed through a die containing holes of suitable size, into a concentrated solution of calcium chloride. In this step the sol is converted into a gel as small, semisolid balls, each of which contains millions of individual microscopic droplets of the liquid encased in cells of the tough membrane of coagulated alginate." At present, the balls produced experimentally by Southwest Research are said to be the size of moth balls and to contain 98% liquid; pellets the size of BB shot are being developed, and the 2% of alginate is being reduced "to a limit determined by the strength necessary to withstand storage problems. Water-washing to remove calcium chloride and drying to remove excess water complete the steps."

The alginate required is at present expensive, but only because it has no other large-scale uses; 1,000,000 tons per year could be cheaply produced in the United States if needed. Use with other liquids than gasoline is receiving much attention—perfume, "kerosine for use in fuel and lighting for rural areas," liquid food products (the alginates are edible), etc. "For processes requiring intimate contact with solid reagents or catalysts, antioxidants, and the like, over considerable periods of time, Carburolith may provide useful techniques." In short, this is a process that will bear watching.

Use of LPG as Motor Fuel Attracts More Attention

IT has long been known that the so-called liquefied petroleum gases —propane and butane, and their mixtures—are of very high octane number. For years, a number of trucks and buses in a few areas have been converted to their use as motor fuels; in the early days of the recent war, a number of motorists attempted to evade gasoline rationing by installing LPG tanks in their cars. However, various technical and economic considerations have always prevented any serious trend toward the use of LPG as motor fuel until—perhaps—now.

Current interest in the subject has been stimulated by the recent announcement that the Twin Coach Co. is producing a new line of passenger buses which consume LPG instead of gasoline or Diesel oil. Advantages claimed are "average savings of up to 2c per mile on fuel alone as compared with Diesel or gasoline coaches; doubling the time between engine overhauls, because the fuel is clean-burning and leaves little carbon deposit; delivered fuel cost, before taxes, averaging from 25 to 50% less than gasoline, and from 10 to 40% less than Diesel fuel in Mid-Continent sections of the country." (2)

The Twin Coach Co. reports that LPG can be obtained on long-term contracts for 2.5c per gal. at the refinery, with delivered prices (in April) of 3.75c per gal. at Amarillo, Texas, 5.3c at Chicago, and 7.75c in New York City, compared with gasoline prices for these three cities of 10.5, 12.4, and 13.4c per gal. "These prices are all before state and federal taxes, but both LPG and gasoline are taxed at about the same rate."

The power plant currently used in the Twin Coach buses has a 10-to-1 compression ratio, which can be increased to 14-to-1 "with any increase in octane rating of the fuel. Right now, octane on LPG runs between 100 and 130. Twin designed the engine especially for high-compression operation, but the company says that practically any gasoline engine can be converted to LPG by installing a new head or special pistons, a special carburetor, and pressure fuel tank . . . .

"On the disadvantage side, there are some major considerations. The biggest problem is handling fuel. Since it is only liquid under pressure, it requires special high-pressure storage tanks. But many refineries have said that they are willing to furnish 30,000-gal. storage tanks on a liberal lease basis." Vehicle fuel tanks, it is said, must be capable of an operating pressure of 200 psi. and a safety-tested pressure of 1,000 psi. "In addition, they have to be specially braced under truck and bus frames to protect them from breaking in case of accidents. In buses, they are equipped with special valves which automatically cut off the fuel if a fuel line is broken accidentally."

At present, the special carburetor employed by Twin is said to cost "about $300, including all necessary fittings, valves, and tubing," although this price would be reduced considerably if quantity production is achieved. "Even at $300, a lot of vehicle operators think the price won't hurt too much, because they figure that they can more than make up for it through fuel and maintenance savings." (3) Propane is the gas given the most attention in the reports on this new type of bus, although butane and propane-butane

mixtures are also mentioned.

Just how much of the bus and truck market will be captured by the LPG's remains to be seen. While these fuels are not generally available at filling stations at present, any large demand could cause these establishments to afford the needed services—just as any large demand for alcohol for alcohol injection would stimulate a similar service.

As regards passenger cars, the future is even more indeterminant, for the LPG's will be handicapped even worse here by the higher cost of initial equipment; many motorists will not stop to calculate eventual savings when asked to pay $300 or more extra for their cars, especially when they cannot see or experience the benefit physically as they can with automatic transmissions and overdrives.

However, high octane numbers, high compression ratios, and cents-per-gallon savings are potent advertising ammunition. If LPG distribution problems appear solvable and equipment costs can be reduced, the future may well see the LPG's battling it out with gasoline for a share of the motor fuel market. Those companies which are currently troubled with a surplus of LPG production devoutly hope that this or some other large-scale market appears for their products—although those companies which also produce motor gasoline will find themselves involved in a dual capacity in any such situation.

Government in Research Requires Close Scrutiny

NOW that the Federal Government is the leading sponsor of research in this country—and bids fair to concentrate its efforts upon increased research in present and other fields of endeavor—it is highly pertinent that all aspects of such research be kept clearly in mind. This was the motive, recently, of Donald B. Keyes of the Heyden Chemical Corp., who, in commenting upon "Government in Research,"(4) pointed out that "huge sums spent by the Government on research, whether fundamental or applied, directly affect the amount of money spent by industry on development. No industrial groups can afford to duplicate research and development work done by the Government at the taxpayers' expense. They simply cannot justify to their stockholders the large development budgets if it means competing with Government.

"It is a well known fact that patents resulting from Governmental research create a situation which further discourages industry from doing its own development. A patent is a contract between the inventor and the Government representing us as citizens. When the Government owns the patent, no such contract exists. The Governmental patent is worthless from a monopoly standpoint, as no monopoly can exist. The greater the expenditure by the Government for research and development, the greater the number of Government-owned patents, for which exclusive rights cannot be obtained, and the less the excuse of private industry to spend money on development. . . .

"It is obvious that some Federal research is beneficial to you as citizens, and, incidentally, to chemical development; but when vast sums of money are spent by Government, these benefits disappear and we will have a liability instead of an asset."

It is particularly unfortunate that the general public has been misinformed as to the nature of patents. Propaganda has succeeded in confusing the beneficial "patent monopoly" with the hated "business monopoly" to the point where dedication of a patent "to the people of the United States" or assignment of one to some branch of the Government is looked upon as a noble, selfless deed, regardless of whether the patent is on some phase of the general welfare or is "simply" another industrial patent. Moreover, the profit motive so elemental in our capitalistic form of civilization is forgotten completely—few stop to realize that industrialists rightly hesitate to invest large sums in building plants to use a process available to all; only when the potential market is obviously of vast proportions—and this is rare—will this factor be disregarded.

The patent grant, or patent assignment, or exclusive license, or a license which included some protection against unlimited competition are all that provide a company with that competitive edge which will incline it to enter new fields or produce old products in better ways. The public is always the eventual benefactor. After a limited period of time, each new process or product is automatically available to all (for whatever that is worth—and that can better be judged after the 17 years of the patent grant). In the meanwhile, the protection granted by the patent grant—to *private* interests—encourages production of new and better substances and the reduction in the price of others.

Not that Government research does not have its place; it does—and few will deny that more money instead of less is needed for Government research into the fields of national defense, public health, and the countless facets of fundamental science and engineering into which industry feels that it cannot afford to explore, regardless of their future importance or the need for a full "storehouse of basic knowledge" upon which to draw in the future. What is needed, apparently, is a real understanding upon the part of both Government and industry of the basic needs and fields of necessary dominance essential to each if our present industrial way of life is not to falter. Mutual distrust will achieve no good end.

Convert Ethylene to Butylene By New Shell Process

AT the recent ACS meeting, Harry A. Cheney, *et al.*, of the Shell Development Co. discussed "Ethylene Dimerization Using Cobalt-Carbon Catalyst" at temperatures below 150° C. and at pressures of 1-100 atmospheres. "The polymer consists of olefins having even numbers of carbon atoms and is predominantly straight-chain. Under suitable operating conditions, polymerization per pass averages approximately 50%, with the product containing about 75% butylenes, 15% hexylenes, and 10% higher boiling olefins."

The significance of this process is readily apparent. During the recent war, many refiners scraped the bottom of their barrels (almost literally) for every available pound of butylenes for use in the synthesis of aviation gasoline (alkylate and hydrocodimers) and synthetic rubber (butadiene), and even adjusted refinery yields of major products to achieve greater production of butylenes. Meanwhile, vast quantities of ethane and even propane were used solely for fuel, since only a minute fraction of their production was needed for the synthesis of ethylene for all of the many uses of the latter (styrene synthesis for synthetic rubber, alcohol production, etc.)

Since the war, however, several new processes have altered the technical and economic picture as regards ethylene. Such processes as Autothermic cracking have made it economic to use ethane as a raw material for ethylene synthesis and to obtain even better yields from propane and butane. Hypersorption and other new separation processes, similarly, have considerably lowered the cost of recovering ethylene from product gases. While butylenes are no longer in such heavy demand, because of the lower requirements for synthetic rubber and alkylate production in peacetime, any near-future war might well see considerable use of a polymerization process for the synthesis of butylenes whose economics are presumably now within the range of consideration.

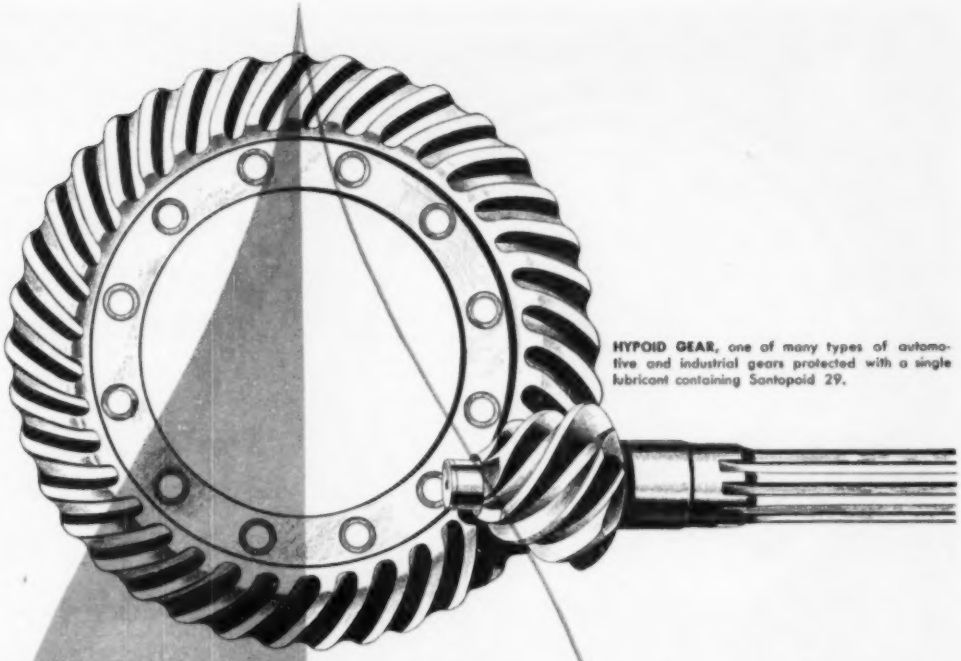
References

(1) Anon., "Solid Liquids," *Industrial and Engineering Chemistry*, 42, No. 5, 7A, 10A (1950).

(2) Anon., "New Buses Use Propane," *Chemical and Engineering News*, 28, No. 16, 1268 (1950).

(3) Anon., "LPG: New Way in Motor Fuel," *Business Week*, No. 1075, 68-70 (1950).

(4) Donald B. Keyes, "Government in Research," *Chemical and Engineering News*, 28, No. 14, 1112, 1113 (1950).



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[*To obtain more data on advertised products see page* 666]

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★TIDEWATER ASSOC. OIL CO. Drumright, Okla.	Houdriflow 4,500 bbl./day	Panellit
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Letters . . .

PETROLEUM PROCESSING this month inaugurates a new feature—a regular column of letters from our readers. We hope you will feel free to contribute to it at any time—to take issue with what we have published, to agree with us if you see fit, or to present your own views on a subject of interest to the industry.

—THE EDITORS

Cold Rubber

We have read the article "Properties of 'Cold Rubber' Not as Good as Natural's" in the February issue ["Tomorrow in Petroleum Technology", p. 100] and were amazed at some of the statements contained in it. We believe that this article could readily create an erroneous impression in the mind of the general reader. . . .

The basic fallacy in the article is in the title itself. Cold rubber is inferior to natural rubber in certain properties but superior in certain others. By stressing the defects of cold rubber and ignoring or minimizing its superior qualities, the technologists quoted have presented a misleading picture. The conclusions reached are at variance with the opinion of many rubber authorities.

Cold rubber was recognized from the start as a *tread type* rubber and it was never claimed to be equal or superior to natural rubber for use in tire carcasses. For tire tread use, the superior resistance of cold rubber to abrasive wear, its superior resistance to cracking, and its greater uniformity give cold rubber a decided technological edge over natural rubber. The statement that "natural rubber has a 25% competitive advantage over synthetic rubber on a technical basis," attributed to the chairman of the board of one of the large rubber companies, is meaningless unless qualified by the end use intended. The days when *any* rubber could be claimed "best for general use" ended with the rise of the American synthetic rubber industry. Today rubber is tailor-made for specific uses. Cold rubber is tailor-made for applications requiring highest resistance to abrasion and for those applications it has no peer. Far from proving "extravagant", the early claims made for cold rubber have been amply confirmed by more than two years of wide-scale commercial use.

Currently butadiene-styrene type synthetic rubber is being produced at an annual rate exceeding 300,000 long tons. Scarcely more than half of that quantity represents mandatory usage. The production of butadiene from petroleum is on a firm and continuing basis and we see no justification for the pessimism expressed in the last paragraph of the article.

Until a suitable synthetic carcass rubber is available, and in all probability even then, the demand for synthetic rubber will tend to fluctuate with the price of natural rubber. Several months ago there was an economic advantage in increasing the use of natural rubber and decreasing the use of synthetic rubber. Today the reverse is true. One must caution against conclusions drawn from relative volume use of cold rubber and natural rubber, based upon consumer demand as of a particular time, without taking into consideration the important factors of both comparative cost per unit of use and comparative quality for each use.

You probably noted that the Kiplinger letter of April 29 (page 3) related that cold rubber tires are living up to the advance advertising, affording 20% to 30% more mileage. I'm sure the Government authorities in charge of the synthetic rubber operations will give you assurance that cold rubber is living up to the early expectations.

G. G. OBERFELL
Vice President
Phillips Petroleum Co.
Bartlesville, Okla.

Graphic Panels

I want to congratulate you on the exceptionally fine way you presented the story on Graphic Panels [April PP, p. 361]. In the opinion of many of our men here at Rochester, it is one of the most comprehensive presentations yet to appear. . .

C. S. CONNER
Taylor Instrument Cos.
Rochester, N. Y.

• . . . have glanced through the article you prepared on Graphic Panels and . . . was very pleased to see that you used a picture of the Pure Oil Hydroformer Panel at Toledo. Some of the other pictures you have are equally as interesting from a historic standpoint. . . It looks like Graphic Panels are here to stay.

R. R. PROCTOR
Instrumentation Engineer
Pure Oil Co.
Winnetka, Ill.

• In the article in the April issue on control panels the author refers to the unit at Great Lakes as being a UOP Fluid unit. It is a Houdriflow unit.

E. SPELLACY
Houdry Process Corp.
Philadelphia, Pa.

Our apologies to Houdry, which some time ago announced that the

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[To obtain more data on advertised products see page 666]

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WORK-SAVER PIPE TOOLS

THE RIDGE TOOL CO. • ELYRIA, OHIO

[To obtain more data on advertised products see page 666]

Letters

Petco Corp. has contracted for a 5,000 b/d Houdriflow Catalytic Cracking unit at the Blue Island, Ill., refinery of its Great Lakes Refining Division.

• . . . you did an excellent job in summarizing the rather confusing Graphic Panel picture. I know that many of our people will find it of much value.

D. M. CONSIDINE
Brown Instruments Division
Minneapolis-Honeywell
Regulator Co.
Philadelphia, Pa.

Black and Blue

I wish to acknowledge and thank you for the excellent review in the April issue of our "Data Book on Hydrocarbons" by Maxwell ["Book Review", p. 409]. . .

There is one point in the review which I should like to discuss . . . For some time the Standard Oil Development Co. has been using dark blue ink instead of black ink for printing technical articles because they have found the former to be more legible. When they discussed with us the publication of the "Data Book on Hydrocarbons", the idea was new to us, and therefore we tested it by preparing the galley proofs in blue and page proofs in black. By direct comparison of the two sets of proofs, we found that their point was well taken, and that the blue printing was indeed more legible than the black. So that you can see this for yourself I am enclosing selected pages from our page proof and galley proof as well as the charts in these two colors.

In discussing this question in the review, the following comment was made: "The choice of blue ink is unfortunate, at least insofar as reproduction of some of the charts is concerned. As a result of printing in blue, some of the essential information on several curves has been all but lost. It is virtually impossible to distinguish, for example, between the subscripts 6 and 8."

The reviewer was justified in saying that a few of the figures in the book are difficult to distinguish. This is caused, however, by the fact that the figures on the original charts were poorly drawn, and cannot be blamed on the blue ink.

WILLIAM R. MINRATH
D. Van Nostrand Co.
New York, N. Y.

PP's book reviewer examined the charts submitted and writes " I can well understand Standard Oil Development Co.'s reasoning after examining the samples of charts. Perhaps there is some lack of uniformity in various copies of the finished book. I re-examined my copy and found my criticism was still well founded." A few more punches like these and we'll be both black and blue.

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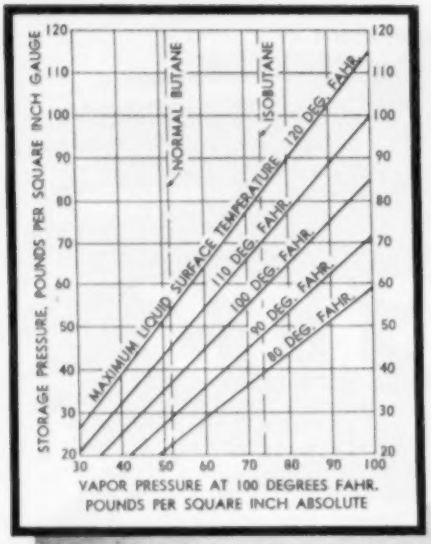

Start here to stop evaporation losses

This chart enables you to determine the pressure for which a tank should be designed to store hydrocarbons with vapor pressures of 30 to 100 lbs. per sq. in. absolute. Locate, at the bottom of the chart, the vapor pressure of the liquid to be stored. Draw a line vertically until it intersects the maximum surface temperature line. Read at either side of the chart the storage pressure required in lbs. per sq. in.

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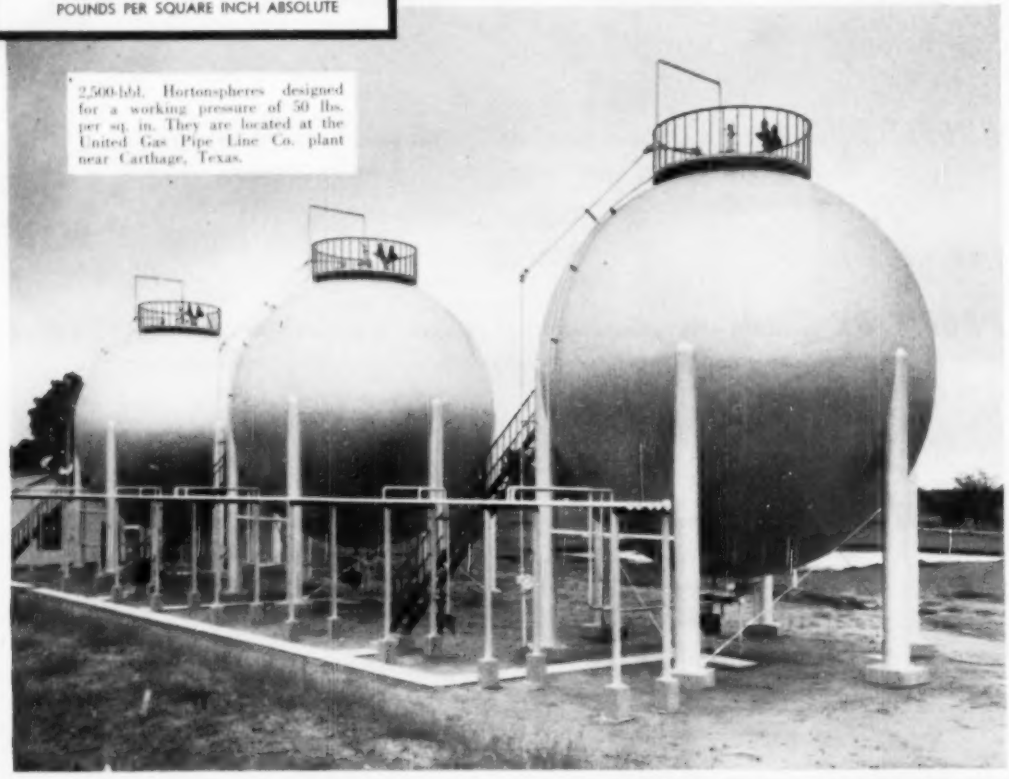

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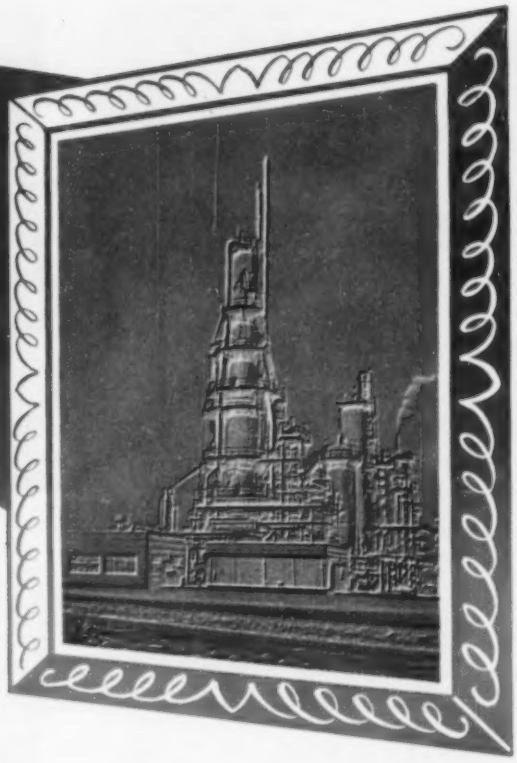
Is your refinery making money?



If your refinery is not making money, REFINERY ENGINEERING Company can show you what you can do to meet today's highly competitive conditions and show a profit.

A prominent refiner gave us a post war modernization contract and 77 days later this refinery was on stream. Recently this firm stated:

"Early this month (March 1950) our cat cracker put through its three-million six-hundred-thousandth barrel of gas oil, completing 365 days of continuous refining at 99 and 93/100 percent efficiency."

"Months ago we saw the trend to high octane motor fuels intensifying — and today we are better than ever able to supply refiners' and jobbers' exacting requirements — up to 82-95 research octane rating."

IT'S NOT TOO LATE!

Building a new refinery or remodeling your old may be the answer to greater profits through the years to come. You can make a determination of your needs and possibilities through a REFINERY ENGINEERING Company study of operating costs, yields, and profits on any proposed construction. Conferences with us will determine the proper type of plant to give you the greatest realization of profit and quickest return on your investment.

You can still have a cat cracker in 1951 if you place an order with REFINERY ENGINEERING Company NOW! CALL TODAY!

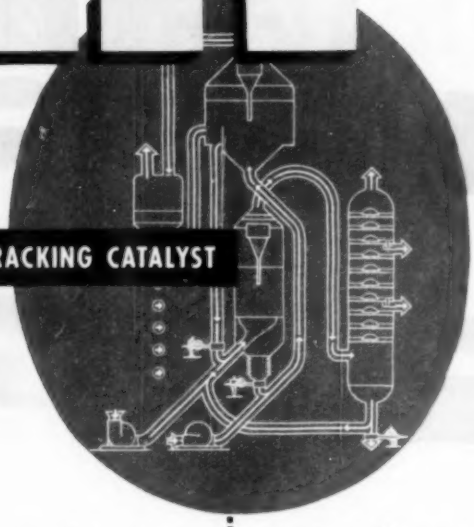
TRECo

REFINERY ENGINEERING Company

PHONE 5-5561 • TULSA, OKLAHOMA

LEADING REFINERIES STANDARDIZE ON . . .

DA-1®



DAVISON FLUID SYNTHETIC CRACKING CATALYST

MAXIMUM catalyst utilization resulting in top efficiency and economy of operation is the reason most often given by leading refineries for standardizing on DA-1. Davison's close laboratory control over production maintains the high standard of uniformity in physical, chemical and catalytic characteristics of DA-1. It will pay you in increased cracking efficiency to investigate DA-1 . . . available in three grades . . .

F-1, Fine Grind—C-1, Intermediate Grind—C-2, Coarse Grind

For special processes, Davison can offer you an experienced staff and a modern, new plant devoted exclusively to the development and production of custom catalysts in granular, powdered or pelleted form.

Requests for information about DA-1—or any other Davison product or service—will secure immediate attention.

Davison offers you—

FACILITIES—Plants located in Baltimore and Cincinnati assure fast service and two reliable sources for your catalyst requirements.

EXPERIENCE—Producers of catalysts since the installation of the first fluid catalyst cracking plant.

SERVICE—New and expanded facilities for catalyst testing and evaluation.

Also producers of:

SILICA GEL • SILICOFLUORIDES
CASTING COMPOUNDS
ALUM • INORGANIC ACIDS
AGRICULTURAL CHEMICALS

THE DAVISON CHEMICAL CORPORATION

Progress through Chemistry

BALTIMORE-3, MD.

Popular Choice for ECONOMY in all Petroleum Processing Conditions

B&W

Refinery Tubing

A Wide Choice of Service-Proved Analyses to meet ALL conditions of corrosion, pressure, temperature and oxidation

Carbon Steel	
Carbon Moly Steel	(½% Mo)
Croloy ½	(½% Cr, ½% Mo)
Croloy 1¼	(1¼% Cr, ½% Mo)
Croloy 2	(2% Cr, ½% Mo)
Croloy 2¼	(2¼% Cr, 1% Mo)
Croloy 3-M	(3% Cr, 1% Mo)
Croloy 5	(5% Cr, ½% Mo)
Croloy 5-Si	(5% Cr, ½% Mo, 1½% Si)
Croloy 5-Ti	(5% Cr, ½% Mo, ½% Ti)
Croloy 7	(7% Cr, ½% Mo)
Croloy 9-M	(9% Cr, 1% Mo)
Croloy 18-8-S	(18% Cr, 8% Ni)
Croloy 16-13-3	(16% Cr, 13% Ni, 3% Mo)
Croloy 25-20	(25% Cr, 20% Ni)

Ask your B&W Tube Representative for detailed technical and application data on any analyses you may require.

B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX TUBE COMPANY

General Offices: Beaver Falls, Pa.

Plants: Alliance, Ohio, and Beaver Falls, Pa.

Sales Offices: Alliance, Ohio • Beaver Falls, Pa. • Boston 16, Mass. Chicago 3, Ill. • Cleveland 14, Ohio • Denver 2, Colo. • Detroit 26, Mich. Houston 2, Texas • Los Angeles 15, Calif. • • New York 16, N. Y. Philadelphia 2, Pa. • St. Louis 1, Mo. • San Francisco 3, Calif. • Syracuse 2, N. Y. • Toronto, Ontario • Tulsa 3, Okla. • Vancouver, British Columbia

TA-1853E

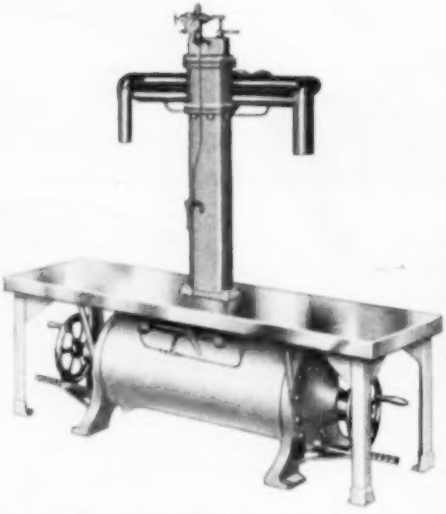
Now!

NEW ACCURACY—NEW SPEED

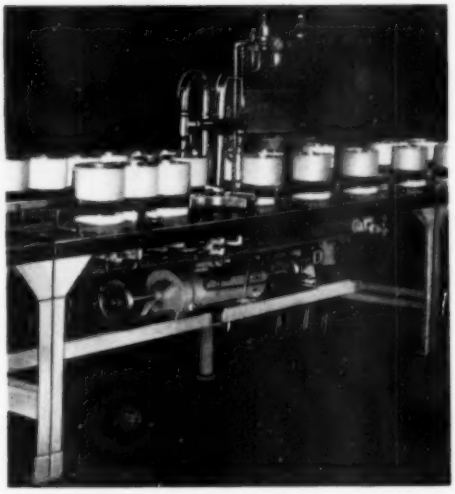
in filling and measuring all greases and viscuous products with GLOBE SPEED FILLERS

Thousands of these fillers are saving time and labor costs every day in the lard and shortening field. Now, this proven technique is available to the petroleum industry, as well. The Globe line of fillers is complete for all needs and sizes, from small, foot operated models, to fully automatic, high production machines.

For faster, "on-the-gram" accuracy, consult Globe today for further information for all your filling needs.



This 20,000 pound per hour capacity Globe Tub Filler fills 15 lb. to 65 lb. containers.



This Globe Filler fills 1 lb. to 10 lb. cans, accurately, at the rate of 100 one pound cans per minute, in a fully automatic belt line production set-up.

GLOBE

CHICAGO

The GLOBE Company

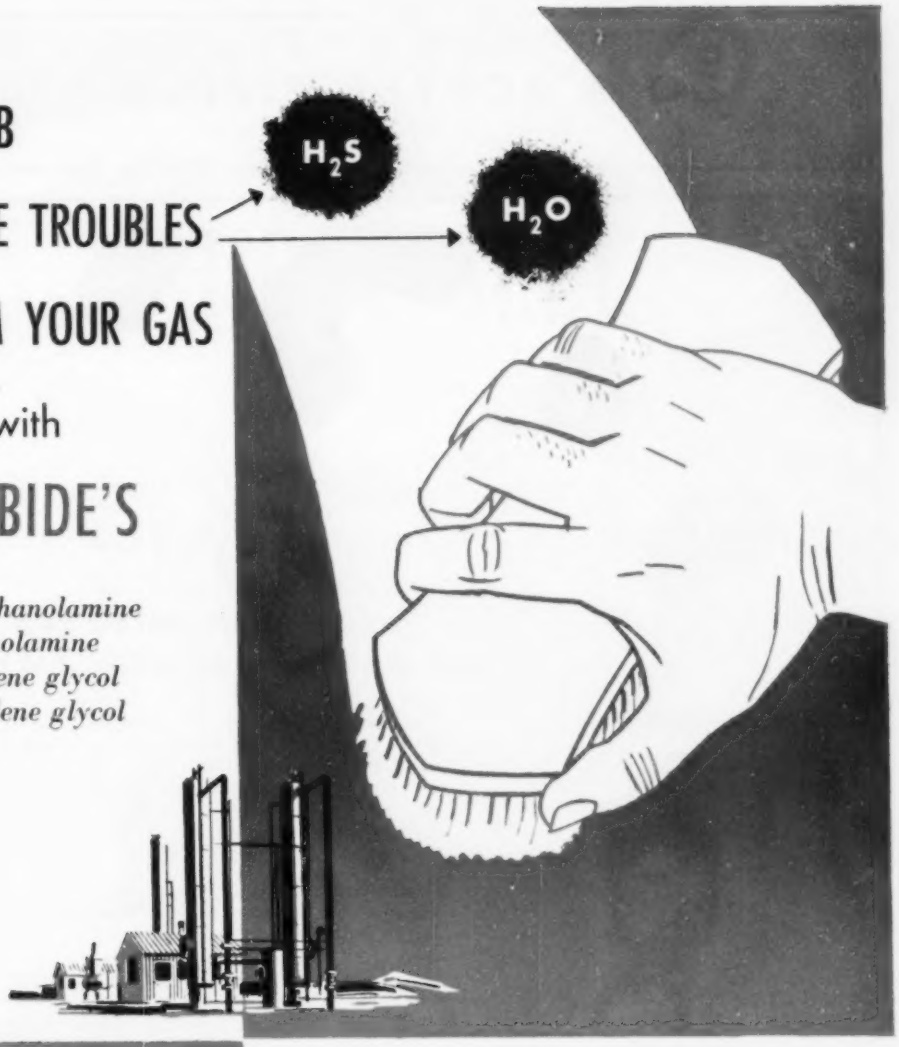
4000 SO. PRINCETON AVE.
CHICAGO 9, ILLINOIS

SCRUB THESE TROUBLES FROM YOUR GAS

with

CARBIDE'S

monoethanolamine
diethanolamine
diethylene glycol
triethylene glycol



CARBIDE AND CARBON CHEMICALS DIVISION

Union Carbide and Carbon Corporation

30 East 42nd Street New York 17, N. Y.

Offices in Principal Cities

In Canada:
Carbide and Carbon Chemicals, Limited, Toronto

DESULFURIZE . . . and eliminate a serious trouble-maker. Monoethanolamine and diethanolamine efficiently scrub corrosive hydrogen sulfide out of natural gas and refinery gas. The hydrogen sulfide removed is a source of saleable sulfur.

DEHYDRATE with the glycols and prevent formation of pipe-clogging hydrates in high pressure transmission lines. This helps you maintain transmission line capacity and avoid valve and regulator clogging.

You can order CARBIDE'S ethanolamines and glycols in tank cars and drum carloads. Delivery of less than carload lots, in drums, can be made from CARBIDE warehouses in Dallas, Houston, Tulsa, Denver, Los Angeles, San Francisco, and 46 other cities throughout the country.

For gas-scrubbing chemicals that do the job, get in touch with the nearest CARBIDE office.

TO DO A BETTER PIPING JOB...

USE

GLOBE

PRECISION PROCESS SEAMLESS WELDING FITTINGS

Your preference for Globe Welding Fittings is supported by a source of supply with exceptional qualifications. Specialized metallurgical experience and facilities gained in years of steel tubing manufacture enable Globe to produce welding fittings by a precision process that yields a superior product.

Send for the Globe Welding Fittings Catalog No. 501.

GLOBE STEEL TUBES CO., Milwaukee 15, Wisconsin

Chicago — Cleveland — Detroit — New York — Philadelphia — St. Louis — Tulsa — Houston — Denver — San Francisco — Glendale, Calif.

SIZE RANGE OF GLOBE SEAMLESS WELDING FITTINGS

Description of Fitting	Standard Weight (Schedule 40)	Extra Strong (Schedule 80)	(Schedule 160)	Double Extra Strong
Elbows 45° Long Radius	½ in. to 24 in.	¼ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Long Radius	½ in. to 24 in.	¼ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Returns 180° Long Radius	½ in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	3 in. to 8 in.
Returns 180° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Reducers (Concentric and Eccentric)	1 x ⅜ in. to 24 x 20 in.	1 x ⅜ in. to 24 x 20 in.	1 x ⅜ in. to 12 x 10 in.	1 x ⅜ in. to 12 x 10 in.
Tees Straight	¼ in. to 24 in.	¼ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Tees Reducing Outlet	¼ in. to 24 in.	¼ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Stub Ends Lap Joint	1 in. to 24 in.	1 in. to 24 in.	- - -	- - -
Caps	1 in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.

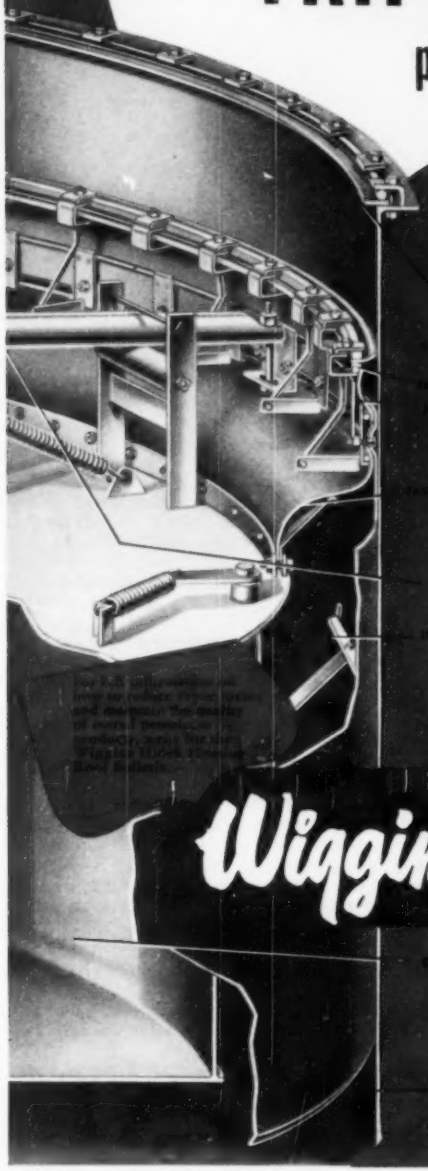
Flanges available 1 inch to 24 inches in all weights

Producers of Globe Seamless Stainless Steel Tubes —Gloweld Welded Stainless Steel Tubes—Carbon — Alloy — Seamless Steel Tubes — Globeiron Seamless High Purity Ingot Iron Tubes and Pipe.

No other floating roof gives you . . .

TRIPLE SEAL

protection



The improved and never surpassed

Wiggins Floating Roofs

GENERAL AMERICAN

TRANSPORTATION CORPORATION

[To obtain more data on advertised products see page 666]

ideal for High-Temperature Bolting

because of its BUILT-IN STRENGTH

You can count on long, satisfactory service when you use the Bethlehem Quenched Nut in the high-temperature, high-pressure bolting applications encountered in refineries.

The Bethlehem Quenched Nut is ideal for use in severe bolting applications because of its built-in strength. This nut is no ordinary nut, punched from a hot bar. Instead, it is *hot-forged*—actually formed by forging and extruding hot metal into a forming die. This is followed by quenching and tempering, which produces a nut strong enough to break any stud or bolt on which it is used.

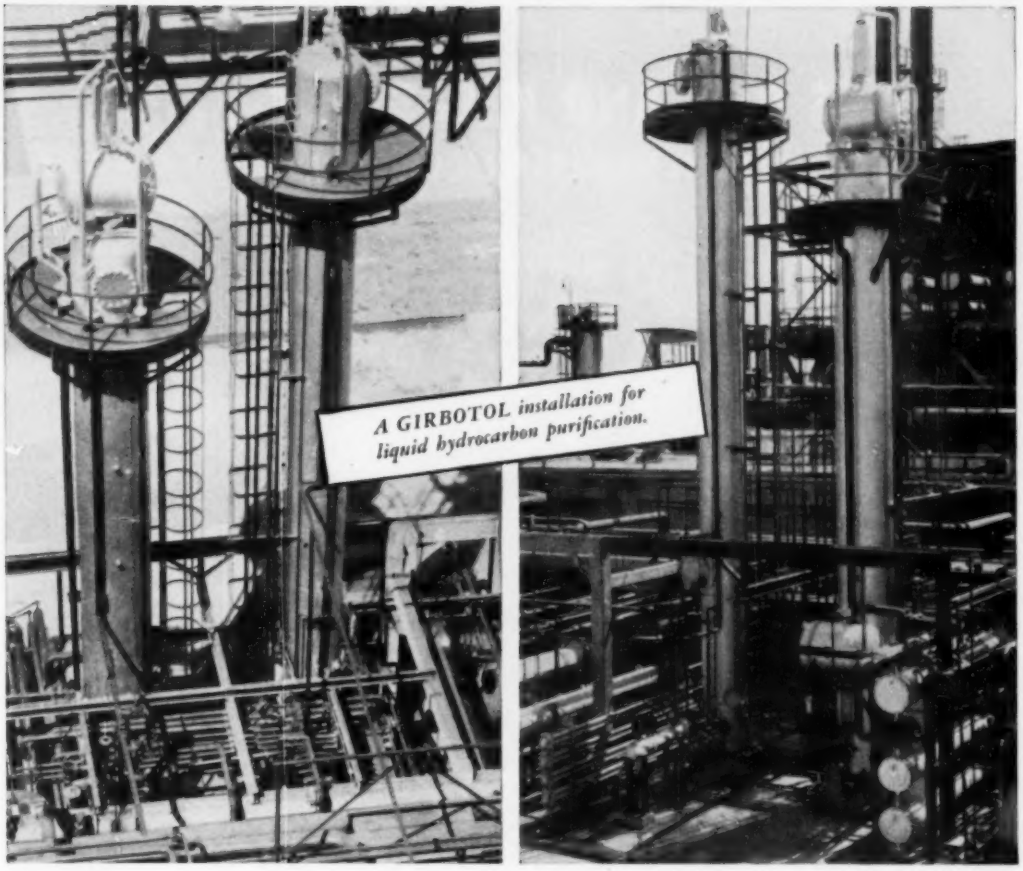
The Bethlehem Quenched Nut has a tough grain structure, and its oxidized sides are resistant to atmospheric corrosion. The nut also has a bearing surface which is far superior to common, machined surfaces.

The Quenched Nut is manufactured at Bethlehem's Lebanon, Pa., plant, and conforms to Grade 2H of ASTM Specification A194. It is carried in stock in bolt sizes from ⅜ in. to 3½ in. Lebanon Plant also stocks nuts in Grades 0, 1, 2, and 4. If you'd like one of our representatives to explain in greater detail the advantages of the Quenched Nut, contact our nearest sales office, or write to us at Bethlehem, Pa.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

Bethlehem supplies every type of Fastening



A GIRBOTOL installation for liquid hydrocarbon purification.

Remove H_2S at low cost with a Girdler GIRBOTOL Plant

MORE AND MORE refiners are realizing the economics of the Girdler GIRBOTOL Process of hydrocarbon purification.

The GIRBOTOL Process is the *accepted* process for purifying gaseous refinery hydrocarbons. Now, more than a score of Girdler GIRBOTOL plants are being used to remove hydrogen sulphide from liquid hydrocarbons such as butane, propane, poly-feed stocks, straight-run naphthas and gasoline.

If you have a liquid stream that contains 500 pounds or more of hydrogen sulphide per day, you can save money with a Girdler GIRBOTOL plant!

Write or call us for Girdler engineering assistance on all problems involving gas manufacture, purification, separation or utilization.

Works speak louder than words

GAS PROCESSES DIVISION

THE *GIRDLER* CORPORATION

LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: 150 Broadway, New York City 7
2612 Russ Bldg., San Francisco 4
311 Tuloma Bldg., Tulsa 3
DESIGNERS, ENGINEERS AND CONSTRUCTORS

PUTS OUT AND KEEPS OUT...

ALL TYPES OF FLAMMABLE LIQUID FIRES

AER-O-FOAM ACTS QUICKLY . . .
PREVENTS FLASHBACKS . . . STOPS LOSSES

In refineries . . . tank farms . . . bulk plants . . . or on the road wherever flammable liquids are produced, stored or handled, guard against losses with "fire-tested" AER-O-FOAM.

In a matter of seconds AER-O-FOAM forms a thick, tough, long-lasting, airtight blanket of foam that snuffs out flames . . . insulates threatened areas . . . prevents flashbacks. "Fire-tested" AER-O-FOAM flows freely and quickly, yet clings fast even to vertical surfaces. It is non-corrosive and easily brushed away when dry.

For quick, "fire-tested" protection of plants, equipment and fleets specify, equip and use National AER-O-FOAM. For complete fire fighting equipment and engineering assistance call on National Foam Engineers.

NATIONAL FOAM SYSTEM, INC.

Headquarters for Foam Fire Protection

WEST CHESTER, PENNSYLVANIA

GRAVER
CONSERVATION AT WORK
for GREAT LAKES PIPE LINE COMPANY
Sioux Falls, S. D., Terminal. Three Graver Expansion Roof Tanks manifolded to 27 Graver cone roof tanks.

A story of a job well done . . .

●Several years ago, Graver built petroleum products tankage systems manifolded with Expansion Roof Tanks for the Great Lakes terminals at Sioux City and Des Moines, Iowa; Watertown and Sioux Falls, S. Dak., and Alexandria, Minn.

So satisfactory was the service of the Graver Expansion Roof Tanks that Great Lakes Pipe Line Co. included Expansion Roof Tanks in the specifications for its $55,000,000 expansion program.

The new Graver installations include five 80,000-barrel Expansion Roof Tanks at Minneapolis, four 55,000-barrel Expansion Roof Tanks at Omaha.

Graver installations at Des Moines (one 40,000-barrel Expansion Roof Tank and four 40,000-barrel cone roof tanks) and at Mankato, Minn. (one 40,000-barrel Expansion Roof Tank and three 40,000-barrel cone roof tanks) will be additions to present manifolded systems. Each of these Expansion Roof Tanks will have a 10-foot lift.

This repeat business speaks for itself—a tribute to Great Lakes' progress and testimony to Graver engineering. Ask for case histories on performance and vapor savings with Graver Expansion Roof Tanks. Write now!

GRAVER

FABRICATED PLATE DIVISION

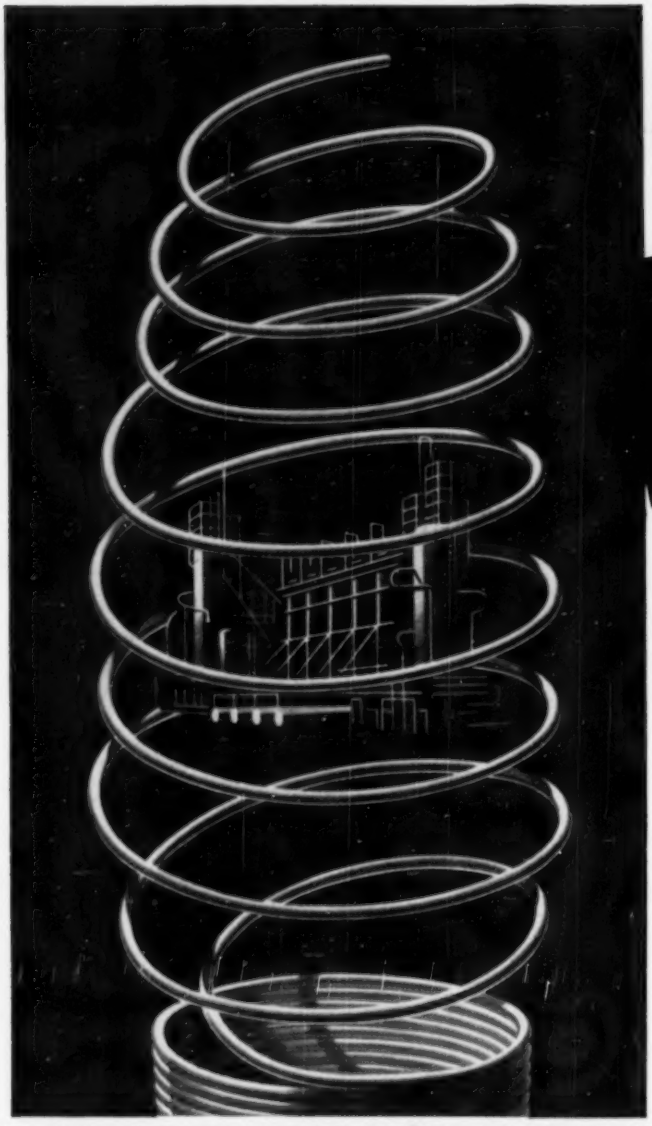
GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

[To obtain more data on advertised products see page 666]

ALCOA ALUMINUM TUBING



resists refinery atmospheres . . .

Cuts Tubing Cost 40%

Save 40% or more on tubing, and get improved performance to boot. Easily formed and flared, Alcoa Aluminum Tubing installs fast. Resists corrosion by H_2S and other sulfurous fumes. Comes in lengths up to 400ft. Ideal for instrument, fuel and air lines. Aluminum fittings available from several manufacturers.

Your nearby Alcoa Distributor has complete tubing stocks, including special alloys for use where vibration is severe. Call him or your local Alcoa sales office today for samples and prices. ALUMINUM COMPANY OF AMERICA, 2168F Gulf Building, Pittsburgh 19, Pennsylvania.

For local source of supply of Alcoa Tubing and other Alcoa products, look under "Aluminum" in your classified telephone directory.

ALCOA

ALCOA *Aluminum* TUBING

INGOT • SHEET & PLATE • SHAPES, ROLLED & EXTRUDED • WIRE • ROD • BAR • TUBING • PIPE • SAND, DIE & PERMANENT MOLD CASTINGS • FORGINGS • IMPACT EXTRUSIONS
ELECTRICAL CONDUCTORS • SCREW MACHINE PRODUCTS • FABRICATED PRODUCTS • FASTENERS • FOIL • ALUMINUM PIGMENTS • MAGNESIUM PRODUCTS

cooling tower fans?

here's a REAL Recommendation!

where the Hartzite cooling tower fan has been tried it has been specified regularly on following towers by the same user

Except in cases of obvious abuse, *not one* Hartzite plastic fan has ever failed. And thousands of them have been installed.

Where there is a battery of towers, one Hartzite fan goes in, then the other towers are Hartzite equipped as replacement becomes necessary. That's the established pattern.

Practically all the leading cooling tower builders specify this fan—many of them exclusively.

Extremely resistant to shock and vibration damage; practically impervious to weathering and the acids and alkalies found in oil refining; stands up well against abrasion.

Hartzell cooling tower fans of 3' to 10' diameter are aluminum; from 10' to 22', Hartzite plastic. For *dependable*, month-after-month economy and safety, *insist* on Hartzell cooling tower fans. Write —or mail the coupon below—now.

HARTZELL

PROPELLER FAN CO.

DIV. OF CASTLE HILLS CORP.

PIQUA, DEPT. K OHIO

Clip and mail now

Send Hartzell Cooling Tower Bulletin 1502

Name_____

Company_____

Street & No._____

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PROPELLER-TYPE FANS AND BLOWERS—ROOF VENTILATORS—UNIT HEATERS • ENGINEERING OFFICES IN PRINCIPAL CITIES

Petreco Desalting

assures maximum salt removal

which
results in
these operating
advantages...

Less crude furnace plugging
Less heat exchanger plugging
Less corrosion in topping unit

These operating advantages directly benefit the topping unit, gaining

An increased service factor
Higher temperatures to the tower
Higher charging rates
Longer runs

Also benefited is the cracking unit, mainly by

Less plugging in the reduced crude furnace

This benefits the unit by permitting

Higher temperatures from the reduced crude furnace
Longer tube life, fewer replacements
Longer runs

PETRECO MAKES SURE THAT YOU GET THE BENEFITS OF MAXIMUM SALT REMOVAL BY MAINTAINING A SERVICE ORGANIZATION WITH PERSONNEL, FACILITIES AND KNOW-HOW UNEQUALLED IN THE DESALTING FIELD

If you are charging salty crudes, and looking for some short cuts to more economical operations – get in touch with

PETROLEUM RECTIFYING COMPANY

5121 So. Wayside Drive, Houston 1, Texas
1390 E. Burnett Street, Long Beach, Calif.

PETRECO

SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PR 50-3

[*To obtain more data on advertised products see page* 666]

Check **The Many Ways—**

Du Pont Field Laboratories

Can Help You...

The start of any field laboratory investigation begins with receipt of samples for study.

CONSULTATION ON TECHNICAL PROBLEMS

To assist in the use of Du Pont TEL Compounds and other additives, Du Pont maintains five field laboratories, each conveniently located in a major refining area to work more closely with you. These are staffed with technical personnel qualified to consult with you and your laboratory personnel on any problem involving the use of additives. This service also extends to assistance on refinery problems such as those involving treating, processing, and others.

HELPFUL TESTS

The tests which are being conducted daily in the field laboratories—for octane number determination, lead content, volatility, storage stability and the like—are generally standard inspection tests . . . but often go far beyond that in results. For example, a tetraethyl lead blending study recently conducted for one refinery demonstrated that a range of over $3000 a day in realization existed among the several schedules under consideration.

FACILITIES FOR EMERGENCY HELP

In addition to handling any regular inspection or antiknock tests, the Du Pont field laboratories can be called on in an emergency to handle refinery control work, check your own laboratory results as well as to conduct special investigations.

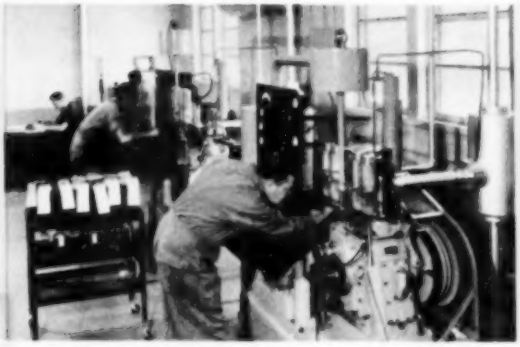
DU PONT

BETTER THINGS FOR BETTER LIVING
. . THROUGH CHEMISTRY

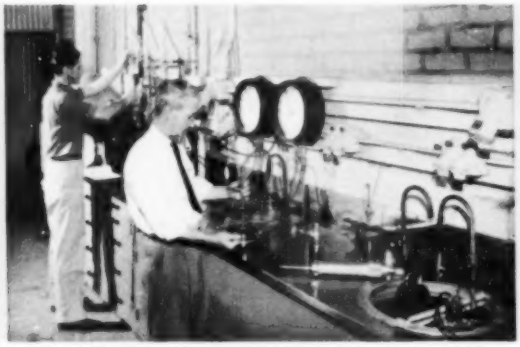
USE DU PONT TETRAETHYL LEAD COMPOUNDS

Du Pont Field Laboratories

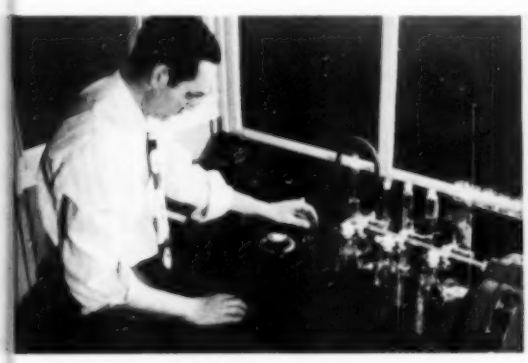
Aid in the Economical Production of Better Fuels



OCTANE RATING AND TEL REQUIREMENT TESTS—Of major help to you in evaluating your fuels and your TEL needs, as well as in checking your own laboratory findings, this service of the field laboratories is also utilized on a nation-wide basis to secure the comprehensive data for the Du Pont Quarterly Motor Gasoline Survey.



ANTIOXIDANT EVALUATION—Determination of a gasoline's antioxidant needs, in terms of the three Du Pont Gasoline Antioxidants Nos. 5, 6 and 22, is another service of the field laboratories. In a number of cases the recommendation of the laboratories has resulted in significant savings in antioxidant costs.



ECONOMICAL COPPER CONTROL—Du Pont field laboratories are equipped to analyze your gasoline for the presence of copper even when only traces are present, and make recommendations for its effective control with Du Pont Metal Deactivator. The use of this additive, as recommended by field laboratories, has helped a number of refiners materially to lower their antioxidant treating costs.

DYE RECOMMENDATIONS—Because Du Pont is the producer of a complete line of gasoline dyes, all field laboratories are prepared to help you select an identifying color for your gasoline. Newest of the Du Pont Gasoline Dyes is Du Pont Oil Blue A, a dye of high tinctorial strength, improved solubility, and meeting MIL-F-5572 Specifications for aviation gasolines intended for military use.

DID YOU KNOW . . . that Du Pont developed and manufactures neoprene, the useful chemical rubber which resists oil, chemicals, sunlight, weather and heat? That is why you'll find in the new cars about 30 vital parts giving improved performance because they are made of neoprene, only one of the many Du Pont products finding use throughout the petroleum and automotive industries.

MAKE DU PONT THE SOURCE FOR ALL OF YOUR GASOLINE ADDITIVES . . .

- **TETRAETHYL LEAD COMPOUNDS** *(Motor Mix — Aviation Mix)*
- **ANTIOXIDANTS**
- **METAL DEACTIVATOR**
- **DYES**

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . THROUGH CHEMISTRY

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division · Wilmington 98, Delaware

District Laboratories: Wilmington, Del. • Chicago, Ill. • Tulsa, Okla. • Houston, Texas • El Monte, Calif.

District Offices: New York, N. Y. • Chicago, Ill. • Tulsa, Okla. • Houston, Texas • Los Angeles, Calif.

A-591

For positive valve sealing

...THE UNCONDITIONAL K & M BELLOWS SEAL!

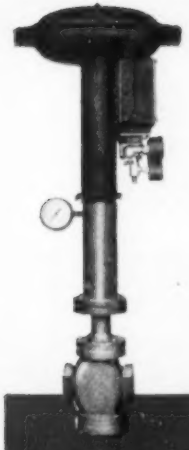
Designed by men who know automatic control valves, the K & M Bellows Seal is the ultimate in protection for valuable or toxic process fluids or in vacuum service where air infiltration would be serious.

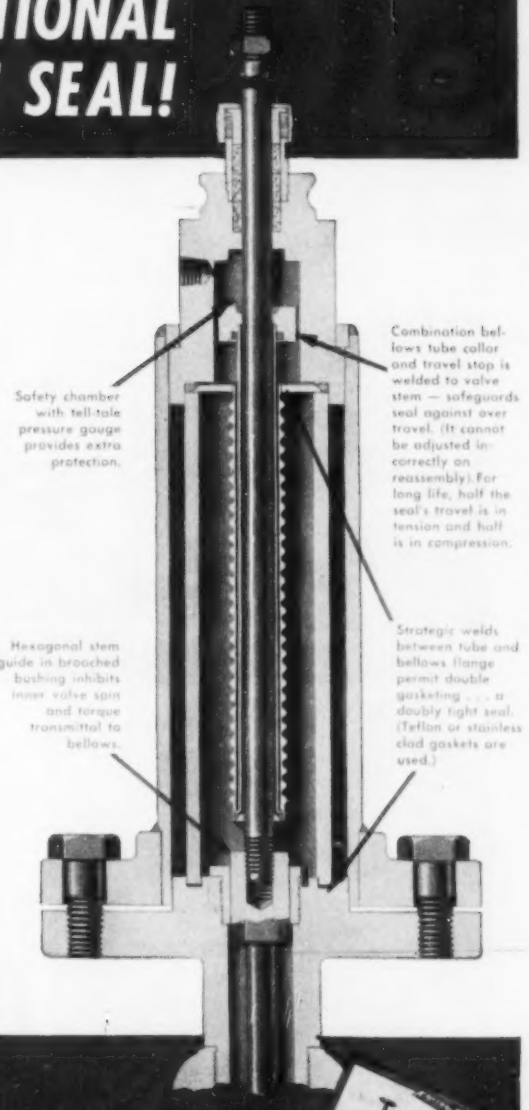
The seal is engineered to be unconditionally leakproof. Its efficiency is assured by its rugged simplicity . . . by ingenious functional extra safeguards inherent in the unique design of the seal itself.

Study the salient features as indicated on the cutaway view. Note also that the tube collar, the inner tube and the valve stem are positively sealed by welds — not threaded parts. The bellows, too, is sealed permanently at the bottom of the inner tube by a resistance weld; thus pressure is confined to the outside of the bellows where it can be more safely taken . . . furthermore, the bellows cannot buckle.

Here is the absolute seal between valve stem and valve body. Simple. Strong. Sure. Constructed of 3 ply Type 347 or 316 Stainless Steel, for pressures to 500 PSI and temperatures to 600° F. the K & M Bellows Seal is available with any K & M Diaphragm Motor Valve in sizes from ½ through 3 inches with full travel in each size.

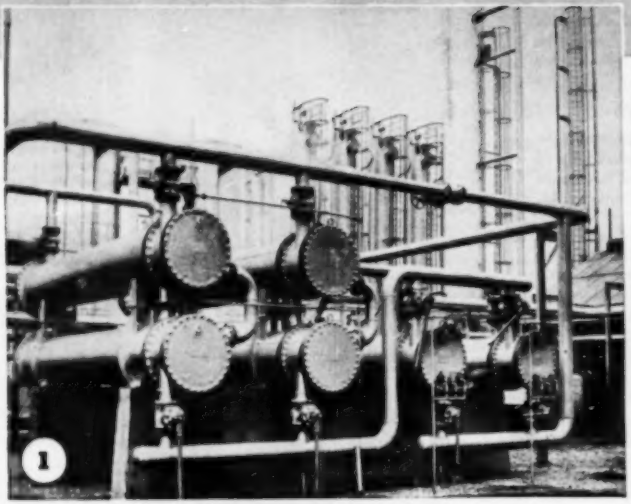
Write for complete details.

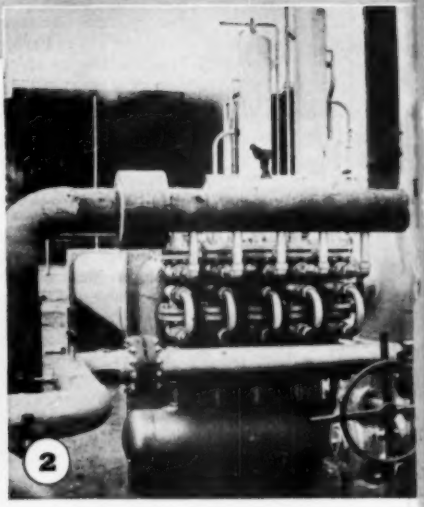


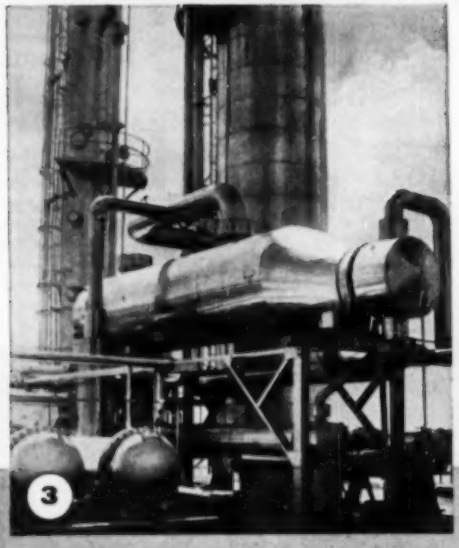

Safety chamber with tell-tale pressure gauge provides extra protection.
Combination bellows tube collar and travel stop is welded to valve stem — safeguards seal against over travel. (It cannot be adjusted incorrectly on reassembly). For long life, half the seal's travel is in tension and half is in compression.
Hexagonal stem guide in broached bushing inhibits inner valve spin and torque transmittal to bellows.
Strategic welds between tube and bellows flange permit double gasketing . . . a doubly tight seal. (Teflon or stainless clad gaskets are used.)

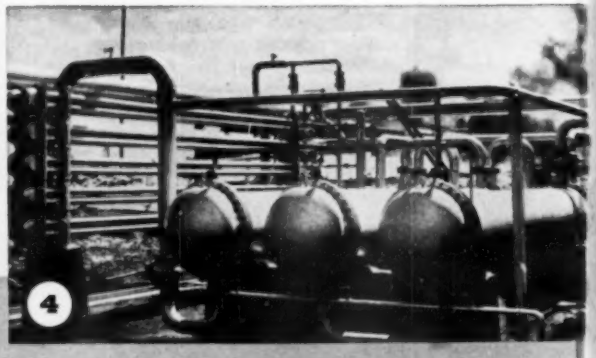
KONTROL MOTOR

Heaters, Coolers, Exchangers,









1. 4 G-R Tubular Exchangers handling glycol-amine on both shell and tube sides
2. 10 G-R Twin Bare Pipe Section Regeneration Gas Heaters
3. G-R Solution Reboiler, and G-R Tubular Secondary Exchangers
4. 10 G-R Twin G-Fin Section Primary Exchangers, and 3 G-R Tubular Secondary Exchangers

GRISCOM-RUSSELL • PIONEERS IN HEAT TRANSFER APPARATUS

Reboilers...all G-R

The El Paso Natural Gas Company has so many installations of G-R Heat Transfer apparatus that a complete list would be difficult to compile.

However, the accompanying photographs, taken at random at Jal, New Mexico, indicate the wide range of services for which the Company uses G-R apparatus. The illustrated G-R units include Twin G-Fin Section Primary Exchangers, Type FST Tubular Secondary Exchangers, a G-R Solution Reboiler, and Twin Bare Pipe Regeneration Gas Heaters.

This company, like so many others throughout the oil and gas industry, has evidenced its satisfaction with G-R Heat Transfer Apparatus in the most unequivocal and convincing manner — by wide use and by repeat orders.

You, too, can be assured of satisfactory service from heat transfer apparatus by standardizing on G-R. When doing so, you get the benefit of the unequalled G-R experience, the extensive variety of G-R designs, and the long-proven merit of G-R apparatus. Whatever may be your heat transfer needs . . . condensing, cooling, heating or heat exchange . . . be sure to consult the G-R engineers for their authoritative advice.

G-R TUBULAR EXCHANGER
A shell-and-tube unit with many distinctive features for efficient performance with minimum attendance and maintenance expense.

G-R TWIN G-FIN SECTION
The "universal" standard interchangeable heat transfer unit with longitudinally-finned elements. More than 40,000 installed sections.

G-R REBOILER
Widely used in process industries, and available with either bare tubes or K-Fin helically finned elements.

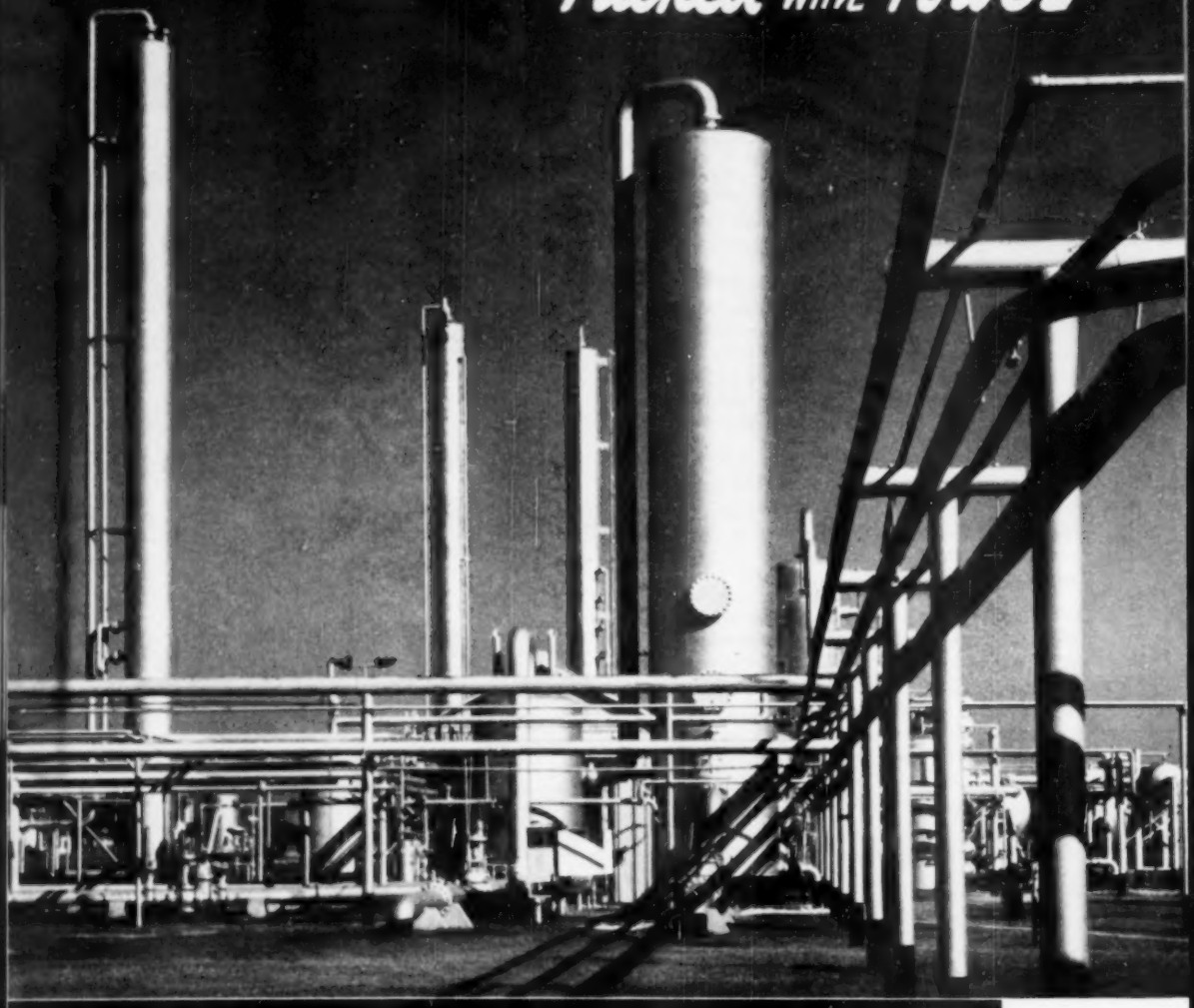
THE GRISCOM-RUSSELL CO., 285 MADISON AVE., NEW YORK 17, N. Y.

GRISCOM-RUSSELL

GR 250

Stabilized

Give You
MODERN
MOTOR FUEL
Packed with Power



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Crude Oil, Natural Gasoline and Liquefied Petroleum Products

To get all piping from one source
Order it from CRANE

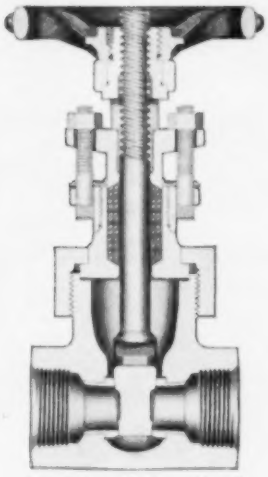
ECONOMICAL SMALL STEEL VALVES FOR OIL AND OIL VAPOR SERVICES

As a matter of fact, these rugged, compact 600-Pound Union Bonnet Gates are an economical buy in more ways than one. First of all, they're moderate in initial cost. And because they are Crane Quality in design, construction and materials . . . routine maintenance costs are negligible.

Stuffing box provides liberal packing space to assure a tight stem seal; male and female bonnet joint is equipped with a soft iron gasket for maximum tightness; body seat rings, securely rolled into place, will not loosen in service.

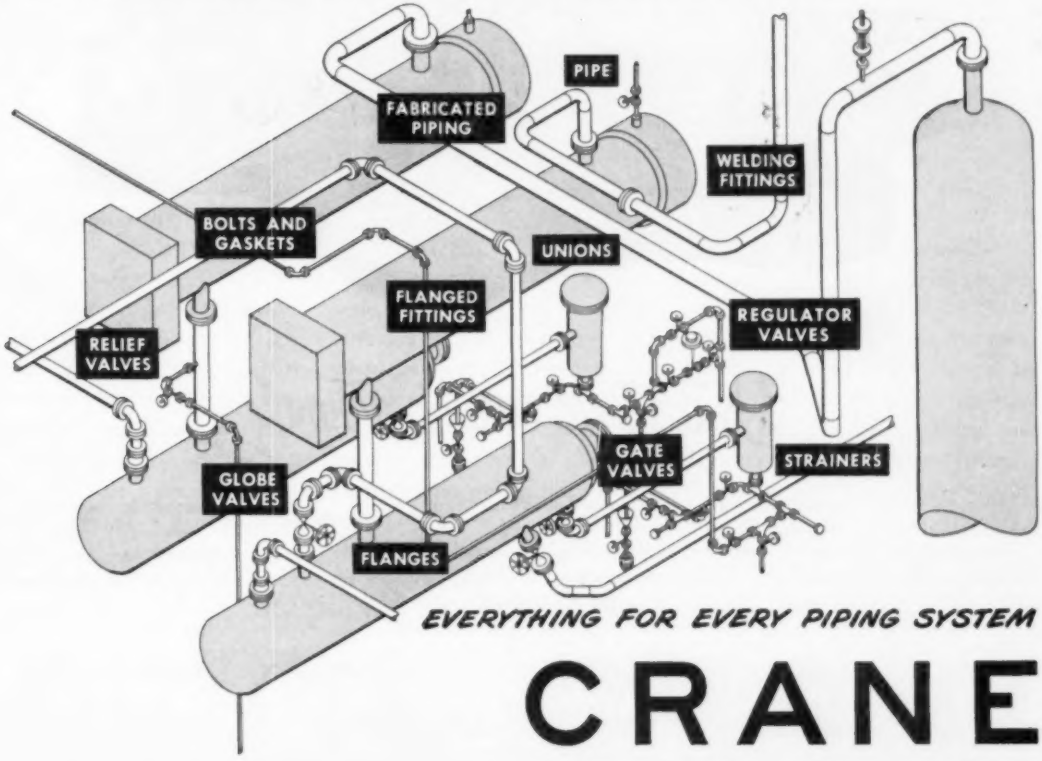
These valves are smooth operators. Guided disc does not get out of line or jam in body. Crane disc-stem connection prevents lateral strain on stem. Accurately cut, easily lubricated stem threads provide positive control with minimum friction. See your No. 49 Crane Catalog.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



No. 3602X, 600-Pound Small Steel Gate for oil or oil vapor up to 1000° F. Exelloy to Exelloy seating. Sizes: ¼ to 2-inch. Screwed or welding ends.

ONE ORDER TO CRANE CAN COMPLETELY EQUIP THIS VAPOR RECOVERY PROCESS PIPING INSTALLATION



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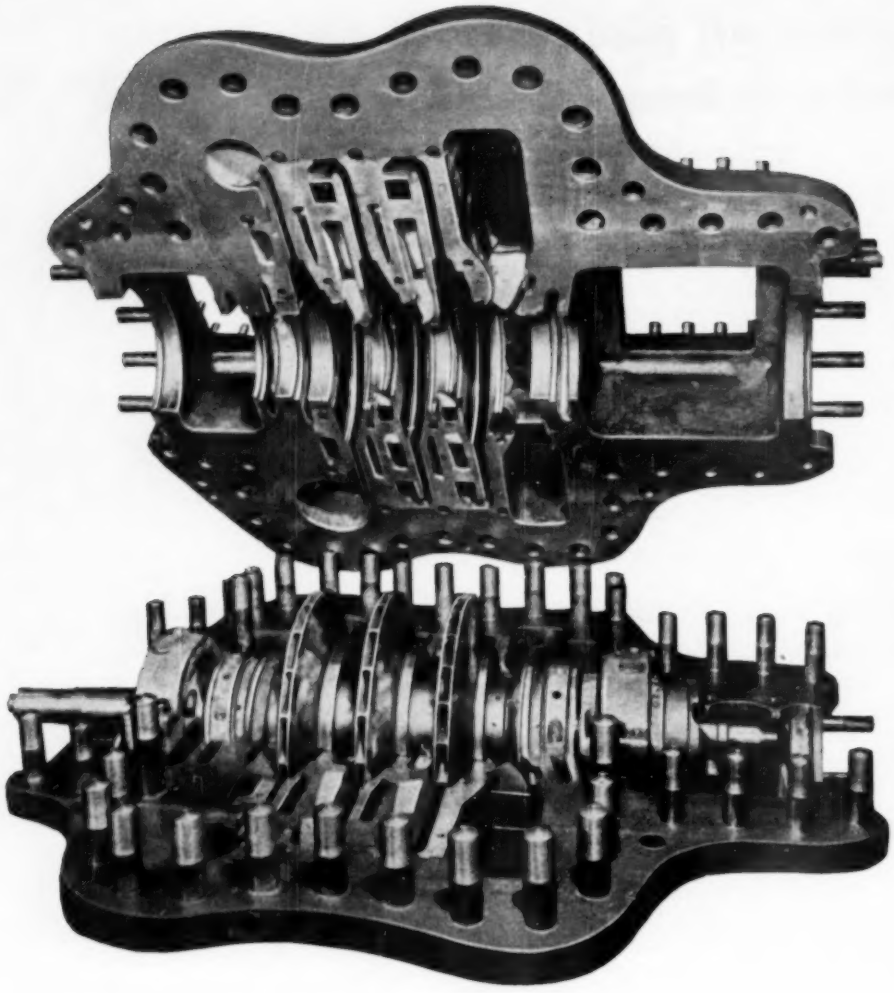
VALVES • FITTINGS • PIPE • PLUMBING AND HEATING



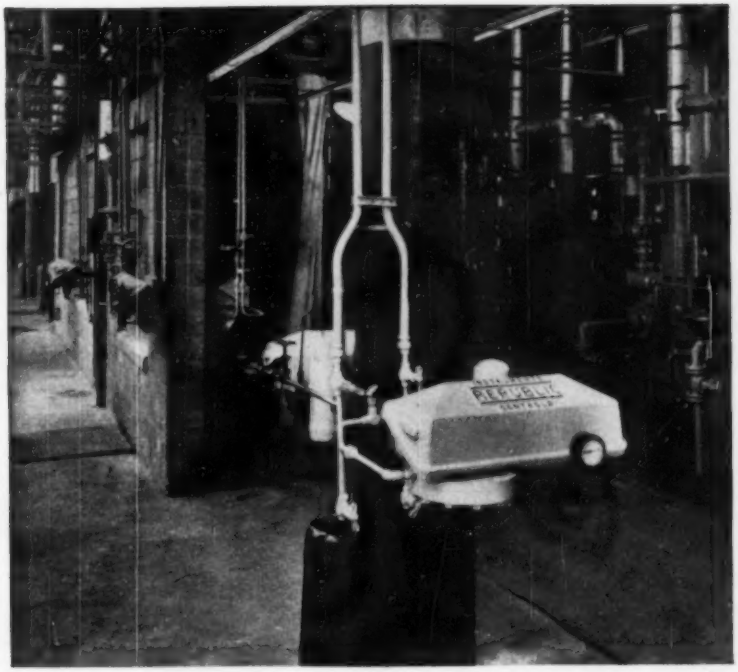
Want to see our operation?

This is something you don't often see . . . the inside of a Carrier Centrifugal Compressor. Because these compressors seldom need to be opened. They are reliable. You can depend on them. They *stay on the job.* Carrier Centrifugal Compressors built over 25 years ago are still operating efficiently with a minimum of maintenance and a maximum of satisfaction.

Here's why. There is only one major moving part. The shaft and impellers are forged of alloy steel, operate below the first critical speed. The casing is cast of semi-steel, withstands pressures up to 300 pounds.

If you have an air or gas compression job that requires continuous, dependable heavy-duty operation . . . give it to a Carrier Centrifugal Compressor. You'll find a local Carrier representative in your Classified Telephone Directory. Carrier Corporation, Syracuse, New York.

Carrier CENTRIFUGAL COMPRESSORS • REFRIGERATION EQUIPMENT



These Meters Had To Be
ACCURATE — FLEXIBLE — RUGGED

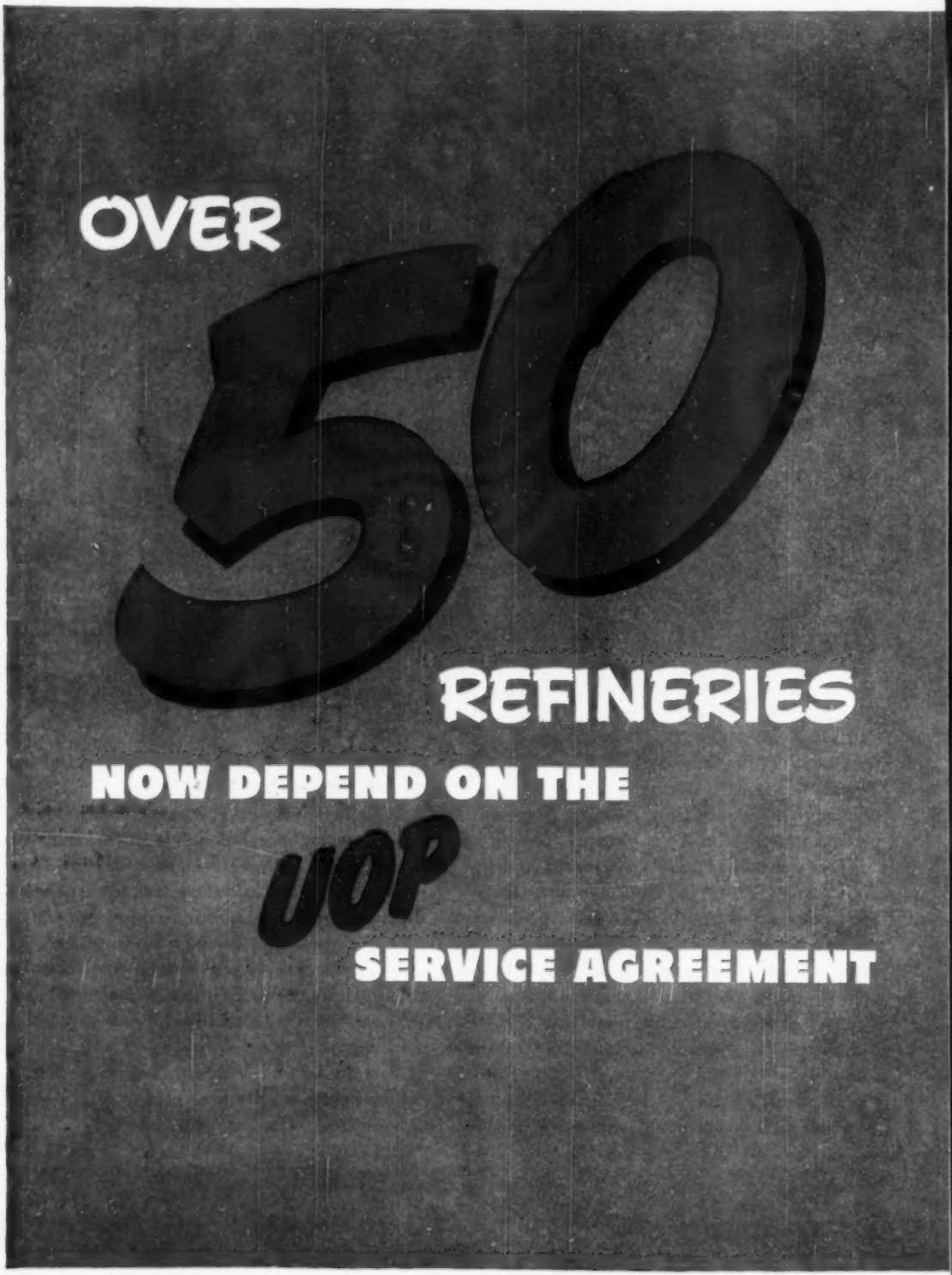
One hundred twenty one Republic Pneumatic Transmitters are measuring the flow and level of various acids in a large chemical processing plant, a section of which is pictured above.

These transmitters have a guaranteed accuracy of within ½ of 1% of the transmitter range. By making a few minor adjustments or substituting a few small parts, their operation can be easily changed to any desired range between a minimum of 0—0.6" of water to a maximum of 0—704" of water. Their construction is more like that of a precision machine than of the sensitive instrument they are. It is for these reasons that Republic Pneumatic Transmitters, even though comparatively new, have already been specified and installed on over 2500 industrial metering applications.

Republic Pnuematic Transmitters are available for measuring flow, liquid level, pressure or liquid density of a wide range of fluids. They employ the force-balance principle to convert these process variables into air pressures which vary proportionally. These air pressures become direct measurements and can be conducted to reading instruments or used as the measuring impulse for the actuation of an automatic controller.

Data Book No. 1001 contains complete details on the construction and operation of Republic Transmitters. Write for your copy today.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois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● Safe, efficient operation is of prime importance to any refiner. That's why more than fifty refineries already have turned to the UOP Service Agreement as the most definite assurance of safe, efficient operation available in the industry today.

The advantages of a UOP Service Agreement are of particular interest to every refiner regardless of size or location. The facilities, services and consultation available under this Agreement cannot be measured in terms of dollars invested, but rather in terms of dollars saved by having a thoroughly trained and experienced service organization available to assist you with the unusual as well as the normal problems of your refining operation.

Consider the benefits of having the advice and counsel of experienced engineers, technologists and refinery service men who are constantly dealing with an extremely wide range of refinery problems in both domestic and foreign operations.

And consider, also, what a UOP Service Agreement will save in "service dollars" while providing smooth, continuous operation of your refinery processing facilities.

Then, let's talk it over without delay.

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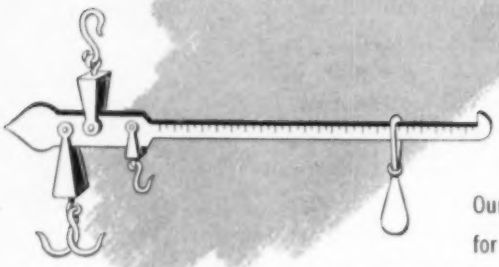
NEW EMPHASIS ON AN INDUSTRY BY-WORD

Universal Service Protects Your Refinery

[To obtain more data on advertised products see page 666]

How "heavy" is resourcefulness?



Ours would weigh nearly four billion pounds, for that's how much Attapulgus Fullers Earth and Porocel Activated Bauxite we've shipped to petroleum refiners.

When weighing resourcefulness—as it applies to percolation adsorbents and solid catalysts—two factors are particularly meaningful: First, the desire of all the people in the company family to tackle problems that require particular skill and broad technical knowledge. Second, the company's physical reach—mines, plant equipment, specialized laboratory and engineering facilities—for good men can do no more than their tools permit.

These resources abound at Attapulgus and Porocel. They dovetail to put a firm base under a completely integrated service. And—for world-wide petroleum refining—to put the right adsorbents to work under the right conditions. May we be of service to you?

ATTAPULGUS CLAY COMPANY *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

Dept. D, 210 West Washington Square, Philadelphia 5, Pa.

Bronze, Iron, Steel and Corrosion-Resisting Valves-

POWELL MAKES THEM ALL!

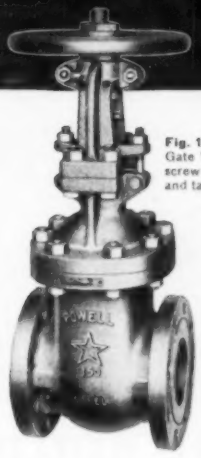


Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

When you come to ONE SOURCE, you simplify your valve buying—and stocking of spare valves and parts—for your entire flow control system.

Powell Bronze, Iron, and Steel Valves are second to none in giving long, trouble-free service. And when it comes to Special Design and Alloy Valves for Corrosion Resistance, Powell is the acknowledged leader. In fact, Powell makes the *only* COMPLETE line of these valves available to Industry today.

Fig. 1793 — Large 125-pound Iron Body Bronze Mounted Gate Valve. Flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge. Also available in All Iron.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable wear-resisting "Powellium" nickel-bronze disc.

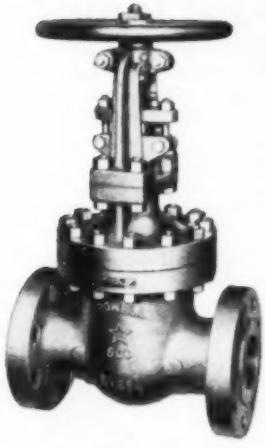


Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.

Ask your nearest Distributor—or write direct

The Wm. Powell Company
Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

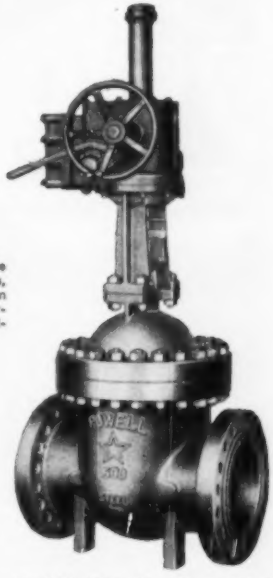
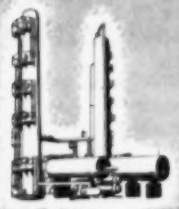


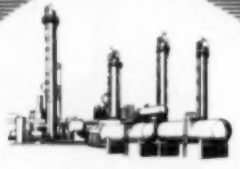
Fig. 6079 M.O. — Class 600-pound Cast Steel Gate Valve for Pipe Line Service. Has flanged ends and bolted flanged bonnet. Motor operated. Also available in Classes 150, 300, and 400 pounds.

POWELL VALVES

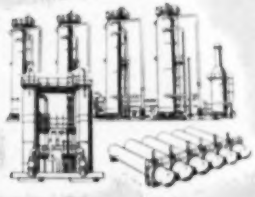
POWER DIVISION



CHEMICAL DIVISION



PETROLEUM DIVISION



NATURAL GAS DIVISION

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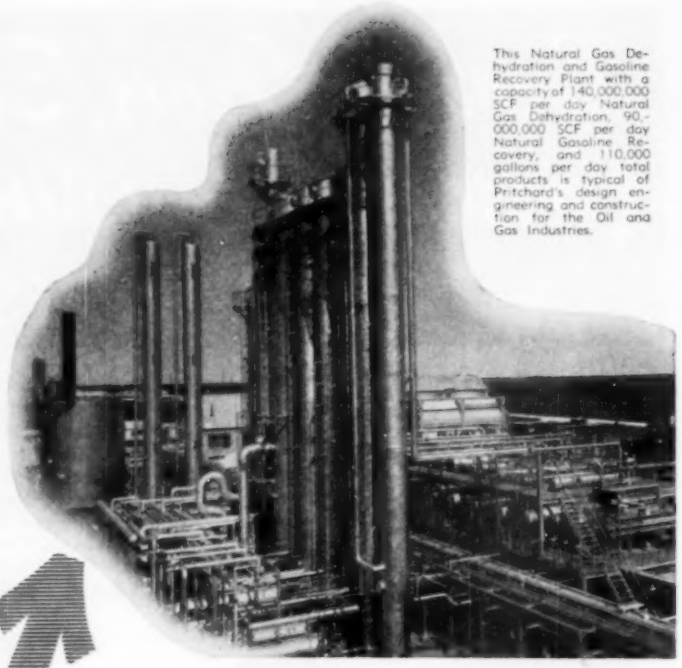

This Natural Gas Dehydration and Gasoline Recovery Plant with a capacity of 140,000,000 SCF per day Natural Gas Dehydration, 90,000,000 SCF per day Natural Gasoline Recovery, and 110,000 gallons per day total products is typical of Pritchard's design engineering and construction for the Oil and Gas Industries.

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We invite you to make use of Pritchard's diversified experience in the petroleum processing field to build profit-producing plants for you.

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ALCOA

Alcoa Heat Exchanger News

PUBLISHED BY THE ALUMINUM COMPANY OF AMERICA

CUT TUBE COSTS AS MUCH AS 80%

Depending on the kind of tubes you now use, savings of 30%, 50% and even 80% are yours by switching to Alcoa Aluminum Heat Exchanger Tubes. These percentages are actual price comparisons . . . foot for foot, metal for metal at the retail levels. If yours is an average-sized refinery, you can save about $50,000 in a single year.

No trick to rolling-in ductile Alcoa Tubes. Standard tools and equipment are all you need. And you'll find aluminum's lightness eases handling and speeds fabrication.

Alcoa Tubes have been on the job for 18, 20, even 25 years without replacement. Their corrosion resistance to ammonia, hydrogen sulfide, carbon dioxide and other contaminants saves you maintenance and repair expense. Alcoa Alclad Tubes successfully resist most cooling waters. They handle steam up to temperatures slightly above 400°F. And in sub-zero processes down to −320°F, and lower, they increase in yield and tensile strengths, show no signs of embrittlement.

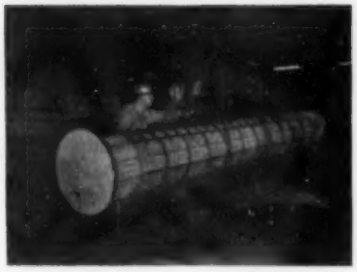
For complete information about Alcoa Tubes and the name of your nearest supplier, call your local Alcoa sales office. Or write ALUMINUM COMPANY OF AMERICA, 1493F, Gulf Building, Pittsburgh 19, Pennsylvania.

* * *

ALUMINUM COMPANY OFFERS NEW BOOK

This new, 24-page booklet will answer many of your questions about Alcoa Tubes. It covers fabrication techniques . . . alloy selection . . . applications both chemical and petroleum. It describes tube cleaning, the use of inhibitors and methods of cathodic protection. It contains complete information on fluid flow and heat transfer characteristics, plus tables of physical properties and specification data. Write for your free copy, today. ALUMINUM COMPANY OF AMERICA, 1493F Gulf Building, Pittsburgh 19, Pennsylvania.

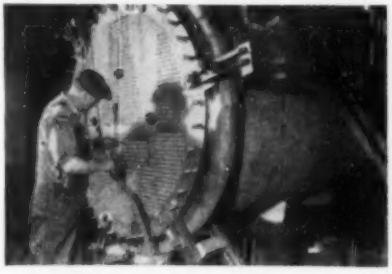
ALUMINUM TUBES EXTEND SERVICE OF COMPRESSOR AFTERCOOLERS



The Ashland Oil & Refining Company of Catlettsburg, Ky., uses Alcoa Tubes in their booster compressor aftercoolers operating at 440 psi and 250°F. The product consists of light hydrocarbon gases with traces of ammonia and hydrogen sulfide. River water is used for cooling. The aluminum tubes are rolled into carbon steel tube sheets with the water-side faces zinc metallized. This procedure provides excellent cathodic protection to the aluminum tubes, although Alclad 4S-F Alloy Tube Sheets would often be recommended.

Installations of this type using Alcoa Tubes have been operating continuously for several years without any sign of corrosion failure. Many utilize salt water for cooling.

TUBING WITH ALCOA ALUMINUM



Aluminum tube sheets should be used wherever possible. For best corrosion resistance, use Alclad 4S-F Alloy Plate. For high operating pressures, use high tensile strength 61S-T6 Alloy Plate.

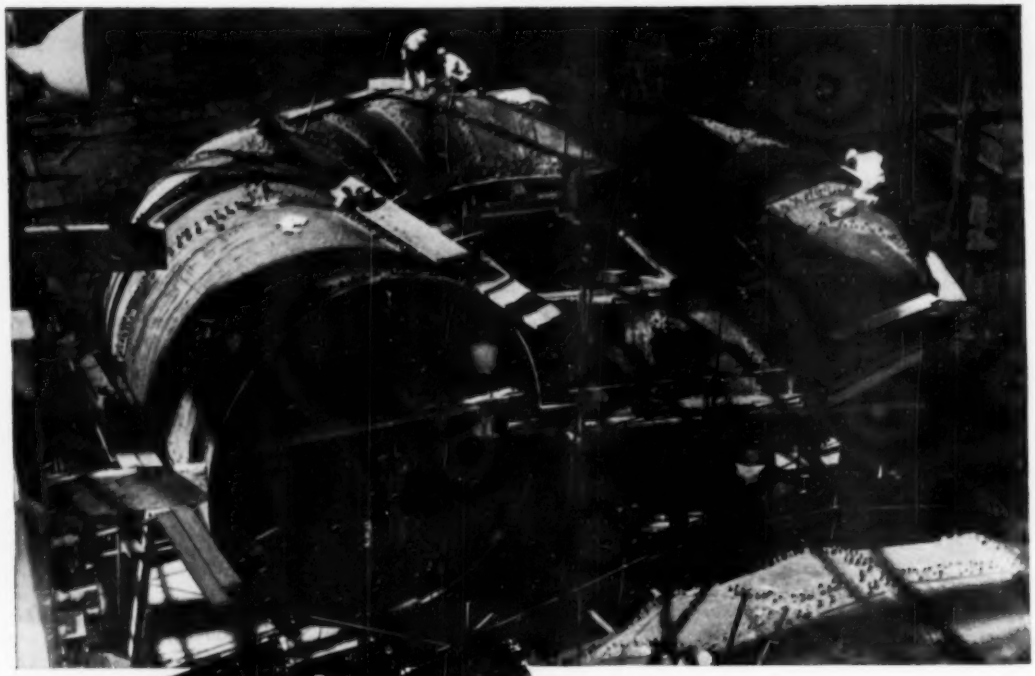
Existing commercial practices should be followed for tube hole spacing. Grooved tube holes afford tighter tube joints, but are not necessary. Standard tools and techniques are used for rolling-in Alcoa Tubes.

The use of steel tube sheets is satisfactory in many fresh, cooling waters. If necessary, cathodic protection may be provided in the form of zinc strips or zinc metallizing of the tube sheets.

It is not recommended that aluminum tubes be used with copper alloy tube sheets, because of galvanic corrosion which can occur.

Complete fabrication, installation and service information is contained in Alcoa's new booklet, "Alcoa Aluminum Heat Exchanger Tubes". Write for your free copy.

[*To obtain more data on advertised products see page* 666]



—and special work too!

Turning out high-performance refinery and chemical plant equipment, record-making tankers and cargo ships is our main business. Such work calls for facilities so vast and skills so varied that Sun Ship also does a wide assortment of special industrial jobs—here, for example, building the scroll case of a turbine for generating electricity by water power . . . Sun Ship facilities and skills are at *your* command.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE (SINCE 1916) CHESTER, PENNA.

25 BROADWAY • NEW YORK CITY

Aiming for higher octanes?

See how THIS Mercaptan Removal Process replaces doctor treating AND

- *reduces TEL requirements*
- *gives you low operating costs*
- *requires a minimum of new equipment*

More than seven years of commercial refinery operation have proved conclusively the high efficiency of the Tannin Solutizer Process* for mercaptan removal. This is the process that brings your equipment up to "new plant" standards in the economical treatment and blending of higher octane gasolines, *without* affecting the stability of the treated product.

Converting to the Tannin Solutizer Process requires a minimum investment in new equipment . . . very likely your present equipment will serve with little change.

Operating economy is an outstanding advantage of the Tannin Solutizer Process. Still another important consideration . . . *this process is not corrosive;* does *not* require equipment of special alloys.

Complete engineering service is available . . . to help plan your unit, to supervise start-up, to assist in later operation if required. We welcome the opportunity to work with you in achieving the many benefits of the Tannin Solutizer Process.

**The Tannin Solutizer Process is licensed under the patent rights of Socony-Vacuum Oil Company and Shell Development Company.*

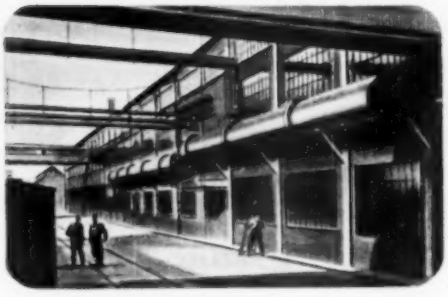
SHELL DEVELOPMENT COMPANY
50 West 50th Street, New York 20, New York

SHELL

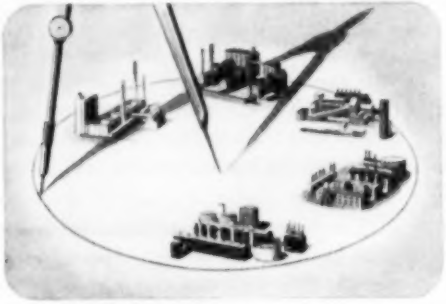
Look for the hidden "extras"

When you specify Solvay in ordering chemicals, you get many advantages that may not be immediately obvious. These hidden "extras" help make your business operate more smoothly, more efficiently . . . and, in many cases, more economically.

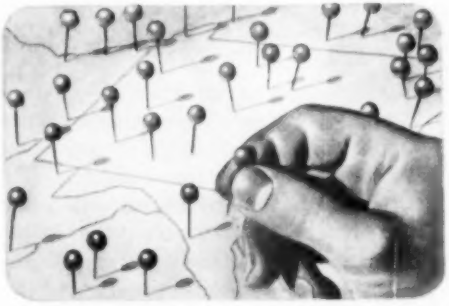
1 **TO HELP YOU WORK** out problems—and to offer advice on the proper use, handling and storing of alkalies—there's Solvay "Industry-Wise" Technical Service . . . a corps of skilled technicians with expert knowledge of individual industries, including *your* industry.



2 **SOLVAY'S LONG EXPERIENCE** as America's first alkali manufacturer—totaling almost seven decades—assures you of chemical products *exactly* the way they should be.



3 **SOLVAY'S FIVE HUGE** plants—situated where American industry is centered—guarantees a steady supply of the materials you need.



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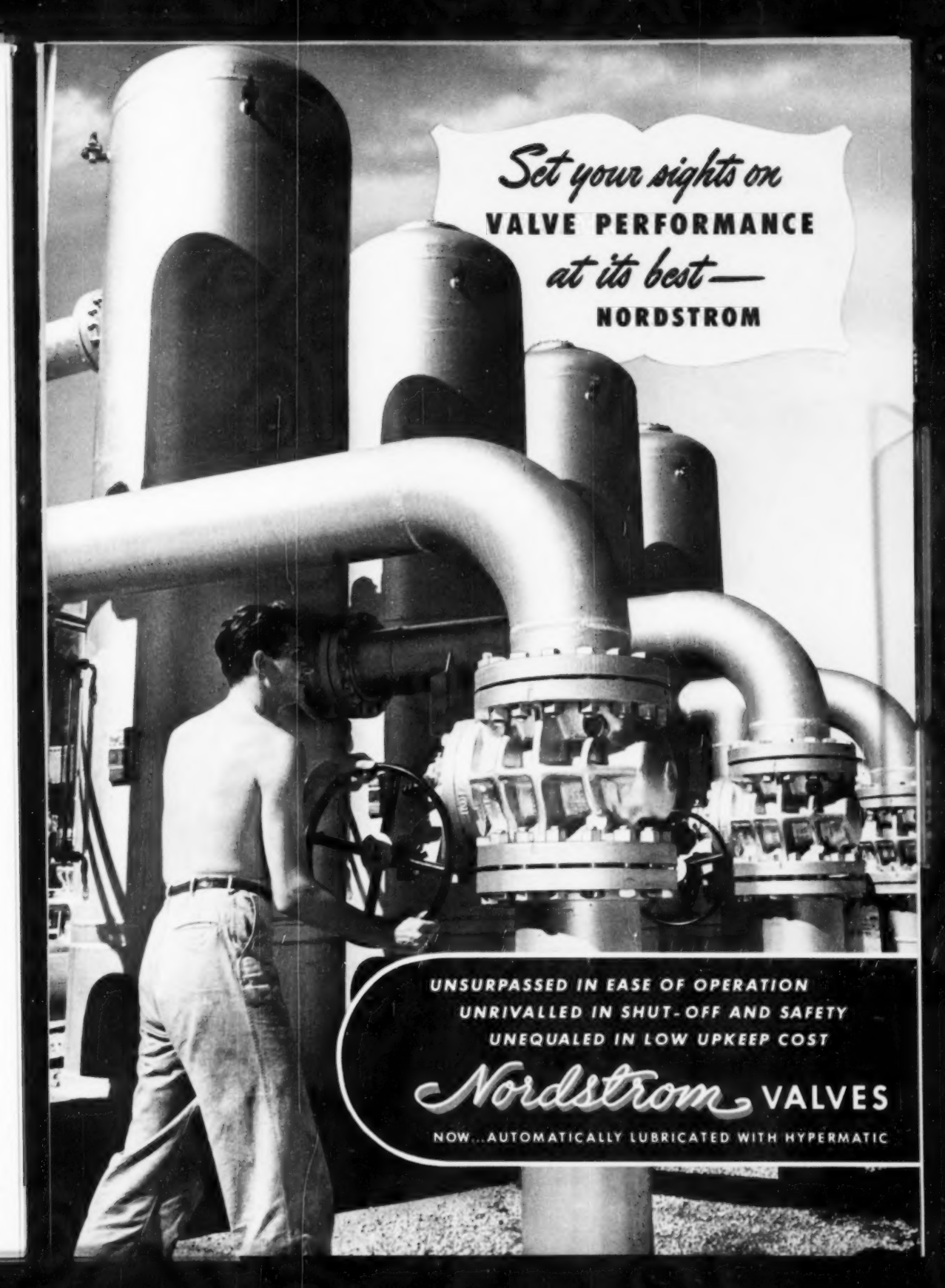
[*To obtain more data on advertised products see page* 666]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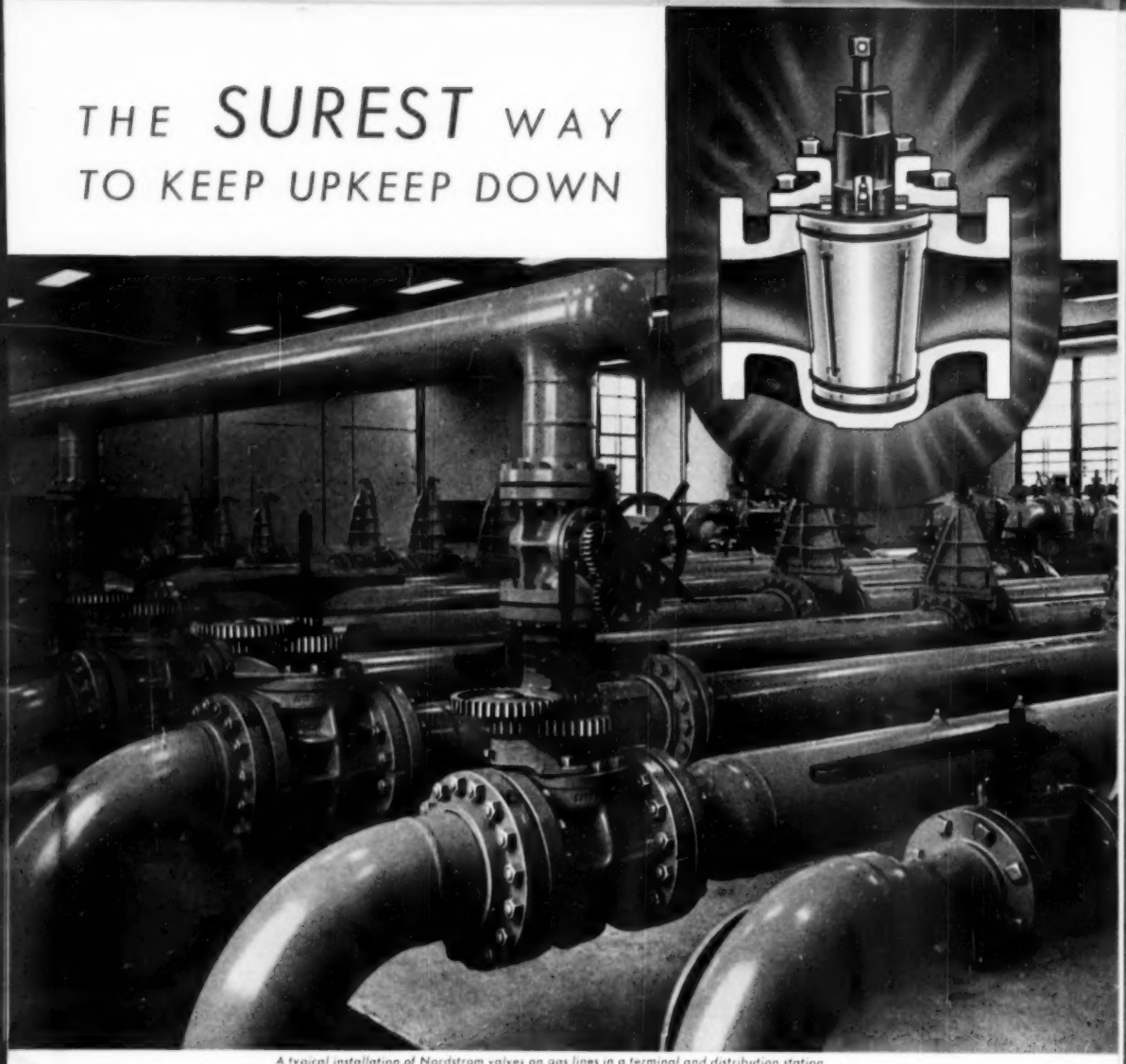

A typical installation of Nordstrom valves on gas lines in a terminal and distribution station.

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less than ½ of 1% of valve purchases

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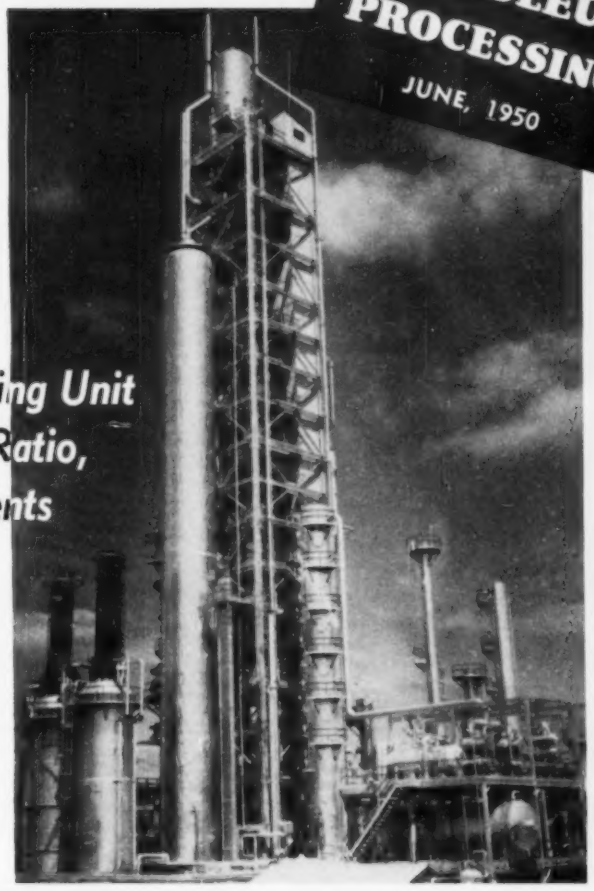
PETROLEUM PROCESSING
JUNE, 1950

THIS MONTH'S COVER PICTURE

First Houdriflow unit in the Southwest is at the Drumright, Okla., refinery of Tide Water Associated Oil Co., and has 4500 b/d charge capacity. Tall tower at left of main structure is catalyst storage hopper; smaller tower at right is main fractionator. Vessel on top is regenerated catalyst hopper, from which catalyst gravitates into the reactor on opposite side of structure (not shown)



New Houdriflow Cracking Unit Has High Catalyst-Oil Ratio, Low Preheat Requirements

By D. P. THORNTON, JR.
Southwestern Editor

THE first Houdriflow catalytic cracking unit to be constructed in the Southwest and the second commercial unit built* is rapidly nearing the date when it will start handling oil. This unit, designed to handle 4500 bbls. per stream day of fresh feed with up to 50% recycle oil, is installed at the Drumright, Okla., refinery of Tide Water Associated Oil Co.

In gaining this distinction, the Drumright plant has lost another. It was one of the few refineries in the country to have a separate, complete natural gasoline plant behind its fences. The casinghead gas once processed there has been sold to another oil company and the old gasoline plant dismantled to make room for the Houdriflow unit. The old compressors now serve the new unit's gas concentration facilities.

The unit was constructed under license from the Houdry Process Corp., Philadelphia. Process Engineers, Inc., Dallas, erected the unit and prepared engineering designs in cooperation with Tide Water and Houdry engineers.

The Tide Water Houdriflow is designed to operate with a maximum catalyst-to-oil ratio of approximately 8:1, the catalyst circulation capacity being 250 tons per hour and system capacity 280 tons. Conventional TCC units, of which the Houdriflow process is a modification, require ratios in the range of 2:1 or 3:1 because of elevator capacity limitations. The greater possible ratio in the Houdriflow design reduces feed preheat requirements, since most of the reaction heat is supplied by the regenerated catalyst.

A unique steam system has been provided in this particular unit to make it self-sufficient and also furnish needed steam to the balance of the refinery.

There is a single bank of cooling coils and two burning zones in what otherwise is a conventional design of TCC kiln for catalyst regeneration. A portion of the flue gas produced is utilized to lift regenerated catalyst to the top of the unit, eliminating the familiar TCC elevator for this service. Locating the reactor atop the regenerator permits catalyst to flow by gravity from the upper catalyst hopper through reactor and regenerator to the lower catalyst hopper.

An elutriator operating on a continuous catalyst slip-stream removes fines from the system. There is no slurry oil stream or precipitator; catalyst losses are not expected to exceed 1.5 tons daily in a unit of this size. It is stated that with this system no carry-over of catalyst fines into the main fractionator is anticipated.

Still unusual, but by no means the first of its type, is the use of a graphic type control panel handling operations of the Houdriflow, gas concentration and product treating units in the new installation.

Tide Water's Houdriflow unit will charge a 29 gravity vacuum gas oil, free from hydrocarbons boiling below 450° F., having an aniline point of 185 and 0.50 wt.-% sulfur, prepared from sweet Midcontinent crude.

It will produce a cracked gasoline of 79-80 Motor octane, clear, or 90 Research octane, clear and amounting to 50% on charge. Other products and yields include a B-B fraction, 15%; tractor fuel, 8%; No. 2 fuel, 14%; cracked No. 3 or 4 fuel,

* The first commercial Houdriflow unit was built at Sun Oil Co.'s Toledo refinery. Of 30,000 b/d capacity, it went on stream last month.

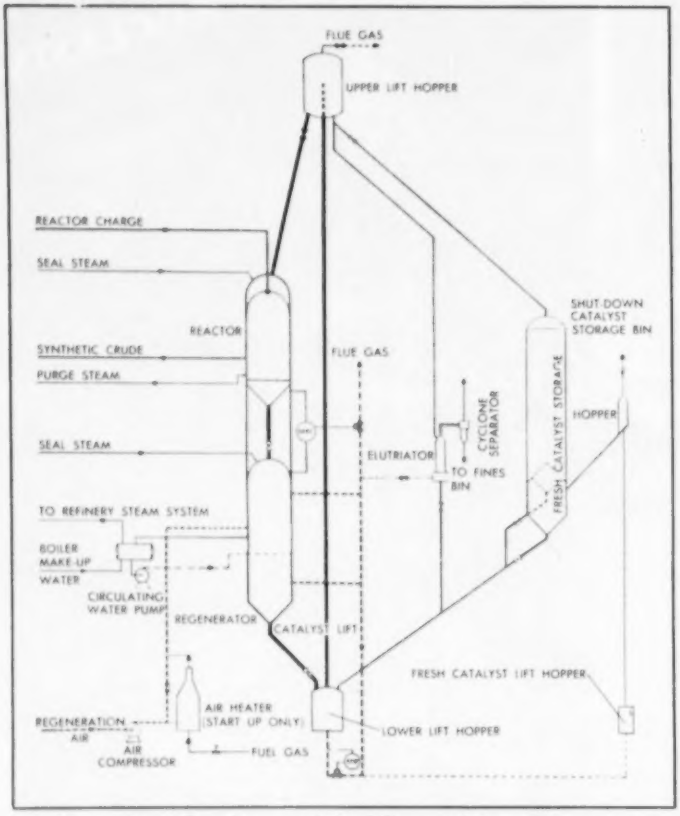


Fig. 1—Above: flow diagram of Houdriflow catalytic cracking process

4%; and clean No. 4 or 5 fuel, 5%. The existing thermal cracking unit will be shut down when the new unit goes on-stream about mid-June.

In view of the relative newness to the oil industry of the Houdriflow process, the entire operating scheme will be reviewed briefly. For further descriptive details and economics of operation the reader is respectively referred to PETROLEUM PROCESSING **4**, No. 2, pp. 137-38 (Feb., 1949) and **4**, No. 5, pp. 554-58 (May, 1949).

Houdriflow Operation

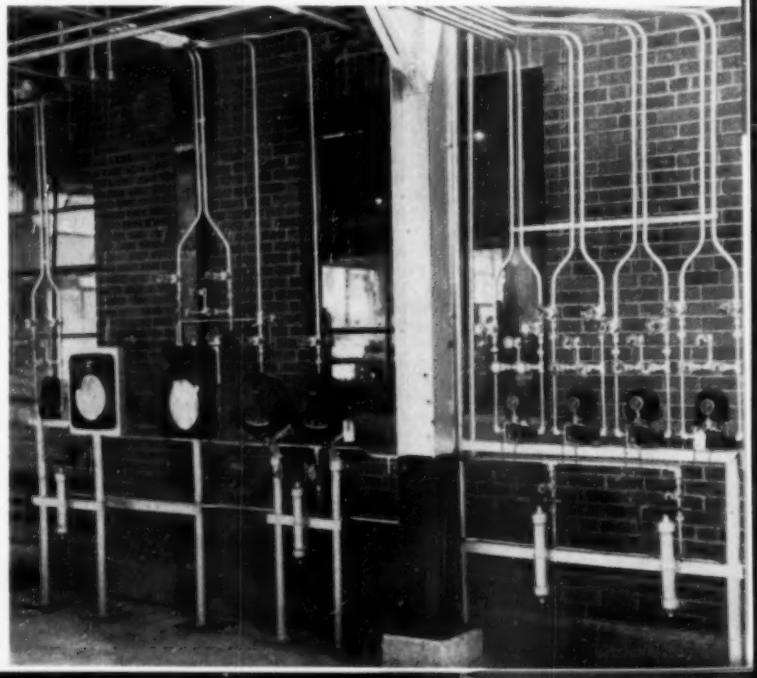
Gas oil to the unit is first heat-exchanged against the heavy gas oil sidestream from the main fractionator, and then its heavy bottoms, before entering a Petro-Chem heater, rated at 15,000 MBtu./hr. absorbed, where a 670° F. preheat temperature is attained. It then is charged into the top of the Houdriflow reactor, as shown in Fig. 1.

Catalyst, entering the reactor (14 ft. x 44 ft. 2 in.) in an annular curtain at the top, is at 1060-1065° F. The partially vaporized feed is sprayed into this curtain, the resulting mixture passing downward in concurrent flow at 850 to 900° F., the usual cracking range. Balance of catalyst above that in the "curtain" enters through passages in the periphery of the inner head of the reactor.

The catalyst disengaging section of the reactor is the same as used in the TCC units and, like them, calls for purging with steam to remove heavy ends from the pelleted synthetic silica-alumina catalyst prior to regeneration. The cracked vapors go directly to the main fractionator while catalyst falls through a seal leg and slide valve into the regenerator.

An interesting instrument, the Gagetron, is used for determining catalyst level in the upper lift hopper. This device consists essentially of several gamma ray sources (radium salts) inside the vessel and a Geiger counter outside. Variation of catalyst level changes the intensity of rays received by the counter, and this level is transmitted to the control panel.

Catalyst entering the 18 ft. 6 in. x 55 ft. 8 in. regenerator through a slide-valve, encounters two burning zones separated by a cooling zone consisting of a single set of five cooling coils, as in the familiar TCC kiln. Varying water flow to these coils gives partial control of catalyst



Right: section of instrument installation outside cold oil pump room: four differential pressure cells (Foxboro) are at extreme right

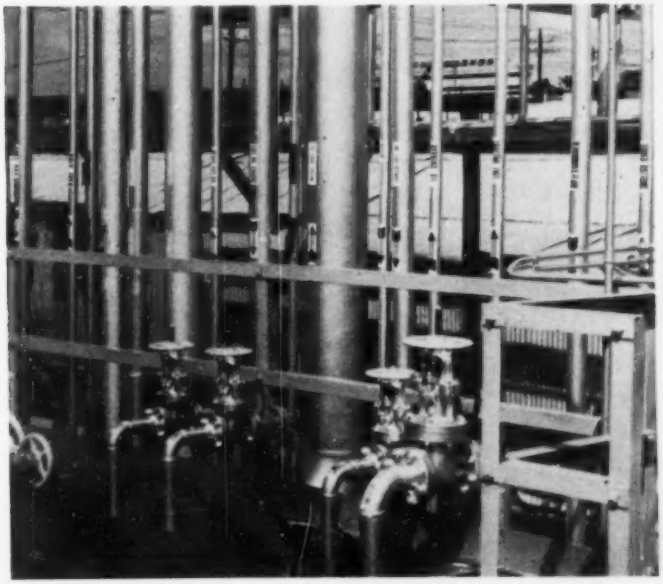
Right: View of gas concentration area showing caustic and water-wash towers with their settlers

temperature and the resulting steam is used for process and power requirements.

A rather "touchy" job of fabrication was successfully executed by Wyatt Metal & Boiler Works, Houston, fabricators of all pressure vessels for the project. In building the cooling zone of the kiln—a circular vessel—the center line of what is in effect a rectangular-shaped tubular heat exchanger extends completely through the vessel on a diameter, and it has a header box on each side. There are five tiers of hairpin-shaped tubes in which steam is generated in cooling the catalyst during regeneration.

Naturally the middle tubes (vertical to the kiln) would be normal to the kiln shell. The fabrication problem for them was therefore simple. Holes to be cut in the shell to take the other tubes, however, are considerably distorted elliptical shapes. So precise was the shop fabrication that engineers report field reaming or forcing was unnecessary, and what was originally regarded as a potentially difficult field erection problem went off without a hitch.

Regeneration air at 11 psig. and 10,000 cfm. from an Elliott blower driven by a Worthington steam turbine, enters just above the cooling zone. It splits into two flows, governed by the proportionate amount of flue gas being passed through two outlets, respectively located near the top and bottom of the regenerator. By suitably adjusting the relative amounts of flue gas passing at these points, a major portion of the burn-off will occur above or below the cooling section, or be approximately evenly divided, for final catalyst temperature control. Thermocouples are installed at various points in the two zones. Regenerated catalyst flows by gravity into the lower lift hopper.



The air-lift principle is utilized to eliminate the need for a bucket-type elevator in returning catalyst to the upper lift hopper. It is not analogous to the Fluidized technique although the effect is the same and there are no moving parts. The arrangement is shown schematically in Fig. 2.

The principal stream of catalyst enters the side of the lower hopper by gravity plus regenerator pressure (8-10 psig.). The upper portion of the hopper is steam-blanketed. The cata-

Left: Transfer piping at cracking unit. All lines and valves marked plainly with adhesive labels denoting product and direction of flow

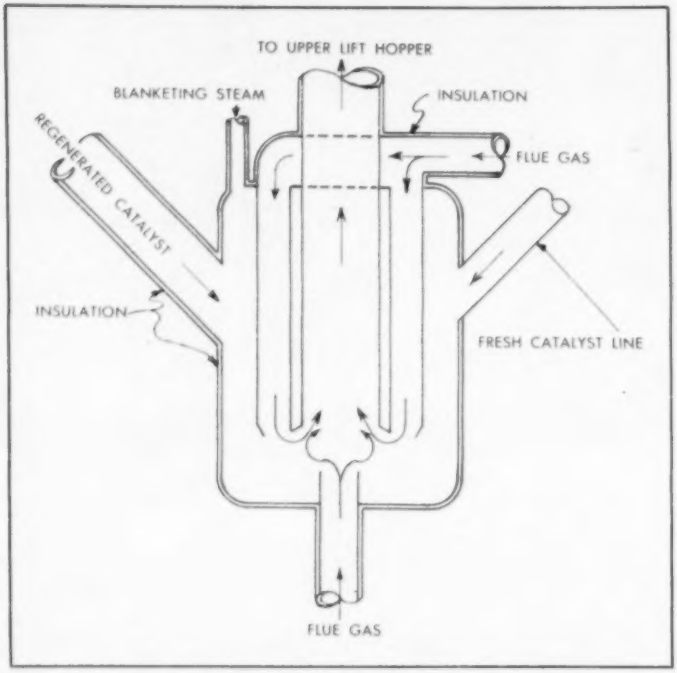


Fig. 2—Above: Schematic diagram of lower catalyst hopper showing application of air-lift principle in moving catalyst to top of unit

Fig. 3—Below: Processing operations of Tide Water's Houdriflow unit at the Drumright refinery

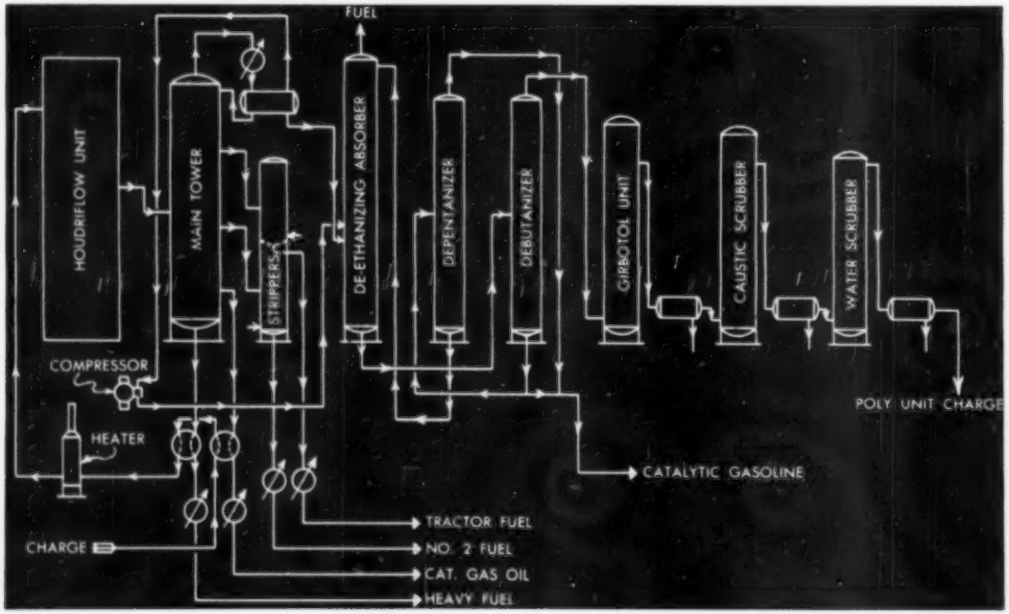
lyst lift pipe leaves the vessel at the top, and surrounding this pipe to enter the vessel is another, carrying a major portion of the flue gas from the regenerator, which provides the lift. At the bottom another flue gas stream enters, to prevent "coning" of catalyst and gives additional "kick" to the catalyst as it enters the lift pipe. Excess fuel gas is vented under control of a back-pressure regulator.

Fresh catalyst from the storage hopper is added to the system at this lift hopper. In the same line is the return from the elutriator.

Referring now to Fig. 3 for the balance of processing, the cracked oil (synthetic crude) is split into five streams by the main fractionator. This vessel, 8 ft. x 75 ft., contains 25 Glitsch bubble trays. The top 7 ft. (to the third tray) is fabricated from monel clad steel plate (Lukens). The 27.5 ft. midsection is plain carbon steel, while the 41 ft. bottom portion is clad with Type 410 stainless. Tray materials conform to the particular alloy cladding.

This provision, while not now deemed necessary with the particular stock being charged, was a "just-in-case" corrosion precaution taken against the day when stock from a sour crude may be charged to the unit.

Two of the fractionator side-streams, Tractor and No. 2 fuels respectively, are steam-stripped. The bottom stripper is stainless-steel clad. The lowest side-stream is not strip-



ped. The piping arrangement is such that this stream may be recycled to the unit or sent to storage as catalytic gas oil as desired.

Main tower overhead is total gasoline make, including all light ends, and is partially condensed. A compressor takes suction on the reflux drum, returning them to the de-ethanizing absorber at 250 psig. This de-ethanizer, fed with main tower overhead and an absorption oil reflux consisting of depentanized cracked gasoline, removes ethane and lighter from the system. Its bottoms are debutanizer feed.

Gasoline make is debutanized, a portion of this stream being depentanized for absorption oil, and thence to storage, picking up the depentanizer overhead enroute. Debutanizer overhead is freed of hydrogen sulfide in a conventional Girbotol unit, caustic washed for mercaptan removal, water scrubbed, and provides feed to catalytic polymerization. Excess butane is sold or used as plant fuel.

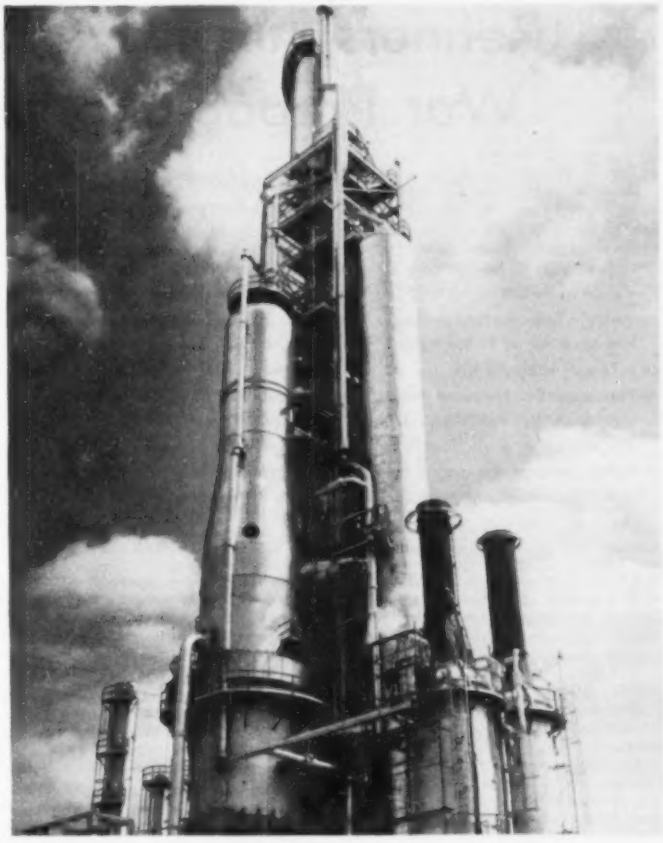
Two unusual features are found in the Drumright installation as operational aids and to help operators learn to handle the new unit. One is the marking of nearly every pipe for contents and flow direction, generally at or near points where control valves are located, in long runs of piping and where lines enter vessels. The other is a graphic type control panel which, though not unique, still is uncommon.

The pipe markers, made by the W. H. Brady Co. of Milwaukee, are called "Quik-Label" and fabricated of strong cotton cloth with a silicone plastic coating. They are said to resist water, weather, fumes and dirt, indoors or out and a strong adhesive backing attaches the marker firmly in place. According to the manufacturer, they are supplied in various color codes and embrace materials listed in the American Standards Assn. Standard A-13. The only contraindication to use yet experienced by Tide Water is on bare, hot pipe; over conventional insulation they have proved satisfactory to date.

While the practice of color-coding process and utility lines is common in chemical plants and becoming common for certain lines in a few refinery installations (notably slurry-oil lines on Fluid units), this is the first refinery installation using adhesive labels instead of stenciling noted by the writer.

The Panellit control panels used at Drumright follow the general pattern described extensively in the literature of late. Two panels facing each other occupy the center of a building whose two ends serve as pump rooms.

In general, all recording instruments are located in racks on the walls of the room behind the control panels with which they are associated. Panel controllers are Moore Products Nullimatics; recorders and measuring instruments are for the most part Foxboro, with several Republic and Brown instruments.



Main Houdriflow structure, showing reactor and kiln, catalyst storage hopper, and Petro-Chem furnaces

Steam production from the cooling zone of the regenerator is apt to vary (perhaps considerably) with control requirements for catalyst temperature, as indicated earlier. For this reason it is believed that at times the unit may not be self-sustaining for process and power steam needs, especially because steam is the principal power source for pumps (Byron Jackson with Elliott and Coppus turbines — Louis Allis motor driven stand-bys) and air blower. Furthermore, the existing refinery steam system was at times already overloaded.

Consequently it was decided to install a Petro-Chem steam generator rated at 25,000 MBtu./hr. absorbed to supply 290 psig. steam, taking up the "slack" from variations in steam generated in cooling the bottoms stream from the main fractionator column and during catalyst regeneration. All sources tie into a common steam drum.

Steam at this pressure is supplied to the 675 hp. air blower turbine. The balance is reduced to 175 psig. to supply all other prime movers. An equalizer line to the main refinery steam system (160-170 psig.) permits flow in either direction. Because most of the "new" steam is used at the Houdriflow unit and a steam drum there would be required in any event, there was no advantage in installing the new boiler at the existing boiler house.

Cooling water facilities include a 30 x 36 ft. Fluor induced-draft 2-cell cooling tower rated at 4500 gpm.

A gas-fired Peabody air heater is provided for initial start-ups of the Houdriflow unit.

Refiners Are Keyed Into Oil's War Preparedness Program

By HERBERT A. YOCOM, Chief
Petroleum Processing Washington Bureau

Petroleum is one of only three essential commodities selected for individual treatment in the matter of preparedness for another wartime emergency. Over the past three years a widely inclusive industry organization has been set up in the Military Petroleum Advisory Board, which serves in a liaison capacity with the military authorities. On the military side, the Petroleum Committee of the Munitions Board has been assigned the responsibility for the industrial mobilization of all petroleum products and the allocation of products to the three branches of the service. Study is being made of the means for screening the oil companies' technical and operating manpower to insure requirements for essential jobs, also of the status of these men under selective service.

WAR, if it comes, will find the oil industry far better prepared than at any time in history to tackle the tremendous task of powering the attack.

It will not be due to sheer happenstance, either.

Rather, it will be the result of the voluntary effort of upwards of 300 oil men, who during the past three years have labored countless hours helping the military—the country—get ready for a day which some believe could come with almost any rising sun.

Thanks to that effort, the military and the industry today know pretty much what can be expected of each other on and after M-Day. Subject always that is, to the qualification that no enemy ever fights according to the plans we make.

Pinpointing this advanced state of readiness is the not widely known fact that practically every refiner in the country with 2,500 b/d crude throughput capacity and over already has a little "ticket" telling him exactly what sort of military products and the quantity of same he should start making when Washington flashes the go ahead.

Painstaking inquiry by a group of industry experts into the ability of these refiners to make military products, or to supply blending components needed by others to insure required production, made possible the preparation and issuance of these "readiness" orders. There is nothing hard or fixed about them, in that they are subject to revision from time to time as conditions change, which it is hoped won't be so frequently as to cause a burden on the individual refiner. Moreover, another survey by this same industry group is now under way to expand coverage to include practically every unit in the refining branch regardless of size.

The story of how we organized and are planning to fuel the possible next war is one that began almost with the end of World War II, and which has been proceeding apace ever since March 29, 1947.

That was the date on which the then Secretary of the Interior, J. A. Krug, carved out of the membership of the National Petroleum Council and directly from the industry what is known as the Military Petroleum Advisory Board, thereby completing a tie up of the military with Interior's Oil and Gas Division.

The function of this board is exactly what its name implies: to furnish the military with the best possible industry advice on the manifold oil supply problems involved in preparing for and actually powering America's resistance to attack. Primarily this was to involve getting ready for the initial stages of a war, but there was to be also much looking down the longer road ahead when total mobilization, it was hoped, would enable the mounting of a full scale counter-offensive.

The primary task of the present is pretty well on the way to being accomplished. And in a very special way, too, out of recognition in high places that petroleum is one of only three commodities so vital to the successful waging of total war (the others are aircraft and electronic equipment) that it should be—must be—separated from the rest and treated individually.

How special is attested by the Munitions Board's recently published Manual No. 40—1 on the Industrial Mobilization Program, which says:

"The reasons for selecting these commodities (oil, aircraft and electronic equipment) for individual treatment are: The special military importance attached to the end items, involved in these three programs; the integrated nature of the industries involved; recognition of the high priority which these commodities will have in drawing upon the nation's resources; and the fact that because all three military departments are so deeply concerned with the use of these commodities that it is not feasible to assign procurement responsibility to any one department."

Thus the military aspects of industrial mobilization planning for all petroleum products and certain by-products and derivatives have been since May, 1949 the sole responsibility of the Munitions Board, which functions through a Petroleum Committee comprised only of top brass and gold braid and with an officer of flag rank—Rear Adm. B. B. Biggs—as the operating head.

Oil Gets Better Standing

The Secretary of Defense, Louis Johnson, realizing the importance of oil, ordered the committee into being as the successor to the old Armed Services Petroleum Board.

The secretary's order established the Petroleum Committee as the top military authority on oil. It was drawn so tight that today if any one of the three services wants anything that is made by a refinery it has got to clear through the Petroleum Committee, no ifs, ands or buts. It provided that the Petroleum Committee was to be the "central agency for the co-ordination of all policy and planning matters relating to petroleum.

This means, of course, only the military side of the picture. Responsibility for planning for the nation as a whole, including the dovetailing of military with industrial and civilian requirements, is vested in the National Security Resources Board. In planning the military's requirements,

however, the Petroleum Committee necessarily has been giving consideration to the probable needs of the civilian economy and endeavoring to cut its pattern accordingly. That is with the full consent of the National Security Resources Board out of recognition of the fact there will be a hiatus between a sudden outbreak of war and the time when, in accord with plans on which the National Security Resources Board is working, a civilian oil agency—probably another Petroleum Administration for War—could be set up and take over. Once that point is reached, the Petroleum Committee will step out of the picture except as a claimant for military petroleum requirements before the new PAW.

At that same point, too, it is contemplated that the widespread industry organization existing through the medium of the Military Petroleum Advisory Board (MPAB) would furnish the skilled nucleus of the government-industry war-oil setup that thereafter would run the show.

Much Better Understanding

So on two counts at least the U. S. today is far and away ahead of where it stood with respect to oil at the outbreak of the last war:

1—There is virtually complete understanding between the military and industry as to what the former likely will require under varying sets of circumstances and how close the latter can come to filling the bill, assuming those same circumstances and assured the necessary materials and manpower. In contrast, World War II was nearly two years gone before anything like this was achieved.

2—Some 300 oil men have had up to three years training for the jobs they would be expected to take on when the call comes.

Less advanced, but definitely ahead of 1941 and profiting by the mistakes made then and subsequently, is the planning for manpower utilization.

This is a task being handled almost exclusively at this stage by the government, and presents simply stupendous problems because no one doubts that when and if we are compelled to take up arms again it will be a case of having to mobilize the total economy in support of the war effort.

More Men in Reserves Now

One problem adding to the difficulties of the planners at the National Security Resources Board arises from the fact that more men are in the military reserves than at any time in our history. That poses the necessity of having to provide some sort of machinery for screening these men—many of whom undoubtedly hold essential jobs in the oil industry—so that any who can contribute more by staying where they are will not be called into uniform.

Tentatively at least, it is the thought at NSRB that it wouldn't be too good an idea to do that screening job now. In the first place, there is a high percentage of instances among the 2,000,000-odd reserves in which adequate information is not to be found in the military files. Besides, a man screened out today because of his job might a year or two hence be doing something of absolutely no value to a war effort.

So, at present NSRB manpower officials are working in the direction of trying to set up screening machinery that would be available for use when mobilization starts. This involves getting an advance agreement with the armed services as to just how screening will be done in individual cases, and by whom—whether by a military or a civilian agency, with one advising the other, or what.

A second major problem receiving careful study is that of moving people through selective service, a field in which exists vast room for improvement. Not much can be written of what has been determined thus far.

Two Major Qualifications

It can, however, be hazarded that NSRB is likely to propose that all persons in what are determined to be critical occupations and employed in essential work, be granted outright deferment from the draft, subject to two major qualifications: 1—That they are not within a certain age group, and 2—that the armed services will have the right to obtain individuals from these exempt occupations upon submission of a special requisition to the manpower agency for persons possessing special skills.

Little has ever been said or published concerning the problems with which the top drawer 20-member Military Petroleum Advisory Board has been wrestling at the Munitions Board Petroleum Committe's request dur-

Top Men in Oil's War Preparedness Program Co-operation

Three men who have contributed much to the co-operation between the military and the petroleum industry on preparedness for possible war. Left to right: Bruce K. Brown of Pan-Am Southern Corp., chairman of the Military Petroleum Advisory Board; A. P. Frame of Cities Service, vice chairman of the MPAB; and Rear Admiral B. B. Biggs, chairman of the Munitions Board Petroleum Committee

ing these past three years. That is so, necessarily, because they involve basic military strategy.

However, PETROLEUM PROCESSING has permission of the appropriate authority to report that they have covered such a variety of subjects as:

The probable maximum rate at which U. S. oil fields can be made to produce, by what means and for how long, plus the industry's requirements in terms of materials and manpower;

The nature and variety of liquid hydrocarbons obtainable to produce the maximum of certain type products;

What would it take to produce liquid fuels synthetically in quantity and whether this would be practical;

The Western Hemisphere's total hydrocarbon balance, including the new factor of an apparently vast Canadian potential;

The ability of the refining branch to shift yields, the limitations respecting same and the cost in terms of steel, manpower and dollars;

What is the minimum below which civilian consumption could not be reduced without impairing a major war effort;

Should there be advance stockpiling of military products and, if so, what products and in what quantity, etc., etc., etc. almost without end.

Some of these studies have been completed in the sense that MPAB has handed in reports thereon. With but one or two exceptions, however, none has been finished in the sense that it is not subject to continuing reconsideration and revisions.

Admiral Biggs explains the reason in a nutshell:

"There is no such animal (he says) as a good static plan. Any plan to be worth a damn must be as dynamic as the events which make such plans necessary."

So MPAB and the military, in these three years, have been exploring up and down the same old streets time and time again, seeking in that way, the admiral adds, to locate and identify the open manholes and thereby reduce the percentage of dropping into them at a crucial moment.

The information which has been gathered and assimilated in this fashion, according to Admiral Biggs, is of incalculable value. Indeed, he has been informed by one individual that facts and figures turned over to the military at just MPAB's last two-day meeting could not have been assembled from other sources in less than a year's time and without the labor of a thousand men. When it is remembered that MPAB has missed only one quarterly meeting in 36 months, the saving in money alone to the government must be sizable, because it is getting the help of these industry experts free of charge.

This industry co-operation with the military works as surely to the industry's advantage as to that of the services. Every time the MPAB tells the Petroleum Committee (PC) that, yes, the industry can do this or that job but that the doing will require such and such materials, that knowledge is communicated to the Munitions Board Material Resources Division which then tries to work those needs into the total picture.

Few people in the petroleum industry are aware of the extensive industry organization which has been built up around the Military Petroleum Advisory Board as the main point of contact with the military atuhorities, or how this agency functions. Problems tossed to the MPAB are generally funneled to one of the six special groups or panels into which its membership is divided: production, refining, transportation, requirements and program. Table 1 shows the personnel of the MPAB.

TABLE 1—Military Petroleum Advisory Board Personnel

Chairman:
Bruce K. Brown, president, Pan-American Southern Corp.

Vice-Chairman:
A. P. Frame, vice president, Petroleum Advisers, Inc. (Cities Service)

Board Members:
Paul G. Benedum, president, Hiawatha Oil and Gas Co.
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Transportation:
Rail and Truck: A. G. Anderson, Socony-Vacuum Oil Co., Inc.
Tanker and Barge: Frederick R. Pratt, Socony-Vacuum Oil Co., Inc.
Pipe Line: B. F. Sears, Shell Pipe Line Corp.

Production:
Dist. 1: None.
Dist. 2: E. F. Cullard, Stanolind Oil and Gas Co.
Dist. 3: Ben C. Belt, Gulf Oil Corp.
Dist. 4: R. S. Shannon, Pioneer Oil Corp.
Dist. 5: Graham Moody, Standard Oil Co. (Calif.)

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Dist. 1: A. J. McIntosh, Socony-Vacuum Oil Co., Inc.
Dist. 2: J. W. Boatwright, Standard Oil Co. (Ind.)
Dist 3: R. J. Gonzales, Humble Oil & Refining Co.
Dist. 4: J. A. Lentz, Continental Oil Co.
Dist. 5: Austin Cadle, Standard Oil Co (Calif.)

In the last few years new oil producing fields have been discovered in the Southwest, Rocky Mountain states and other areas over the country which are important sources of crude supply for the petroleum industry. To acquaint refiners with the nature and characteristics of these new crudes, PETROLEUM PROCESSING has arranged with the Bureau of Mines Petroleum Experiment Station at Bartlesville, Okla., for the preparation by its technologists of a series of articles which will present helpful data on the refining properties of these many new crude oils.

As a result of its work over many years, the Bartlesville station has developed special techniques for routine analysis of crude oils. Its reports on these analyses, published in official bulletins and other forms, have been of great help to the industry in supplying data to aid the individual refiner planning to process the crudes. During the war, the Bureau's studies were successfully applied, among other uses, in classifying crudes as to their suitability for the manufacture of aviation gasoline and toluene.

The Bureau's techniques for the analysis of crudes are now being applied in its studies of oils from the new fields which have been recently discovered, the results of which studies will be reported in the special articles in PETROLEUM PROCESSING. The accompanying article discusses the Bureau's technique of analysis and gives an example of its application in determining the characteristics of a specific crude oil. The second article will cover crudes from the new Scurry County, Texas, field and adjacent areas.—Editor

Refining Properties of New Crudes

By N. A. C. SMITH, H. M. SMITH and C. M. McKINNEY *
Bureau of Mines Petroleum Experiment Station, Bartlesville, Okla.

Part 1—Significance and Interpretation of Bureau of Mines Routine Crude-Oil Analysis

The typical Bureau of Mines technique for the routine analyses of crude oils is discussed, together with their interpretation in terms of the refining characteristics of the oils. One analysis is discussed thoroughly and comparisons made with other analyses. Methods of comparison involving graphic representation and comparison by means of the Correlation Index are pointed out, as well as other characteristics of the crude that must be considered in making an exact comparison.

The significance of the various determined and calculated properties shown in the report of the Bureau of Mines routine crude oil analyses are discussed, and examples of their usefulness are given. Finally, the interpretation of the routine crude oil analysis in terms of commercial products is discussed and examples of their usefulness are given.

The material in this article forms a background for following articles which will present the characteristics of important crude oils from various fields in the U.S.

THIS series of articles will describe the characteristics of crude oils obtained from recently discovered fields in the U. S. which are important because of potential production, or because they are significant new developments. This first article will describe a typical Bureau of Mines routine analysis and discuss its significance and the interpretations that may be made from its data. Several articles will follow describing the crude oils produced in areas in Texas, Oklahoma, Kansas, the Rocky Mountain Region, and possibly other areas that have recently become important.

It would be impossible in a series of articles of this sort to give detailed analyses of all of the crude oils with which the subject matter will be concerned, and the reader will be referred to various publications of the Bureau of Mines that give these routine analyses in detail. In general, the series will attempt to point out similarities between the new production and other production in the same or adjacent areas, or from the same or adjacent geological producing formations. Such information may have value in consideration of the relationships of the oil sources to other oil-producing horizons in the vicinity.

In addition, suggestions as to the probable value of the crude oils for refining to commercial products will be made. It must be borne in mind, however, that the routine analysis is not adapted for, and was not specifically designed for, the evaluation of a crude oil in terms of the products an individual refiner can manufacture. It is more a "snap shot" of the crude oil and indicates possibilities that may be explored by more complete analysis.

The first article, in addition to discussing a crude-oil analysis, will point out the criteria by which similarity or dissimilarity of crude oils may be inferred, and then will discuss briefly some of the specific physical properties represented in the analysis, the interpretations that may be made from them, and indications regarding utilization of the crude oil.

The Bureau of Mines Analysis

A typical routine analysis by the Bureau of Mines method is shown in Table 1, which presents the data obtained by specific tests on a sample of crude petroleum and by an analytical distillation of the sample. In the distillation, the crude-oil sample is separated into a series of 15 (distillate) fractions and an undistilled

* Both N. A. C. Smith and H. M. Smith are Petroleum Engineers and C. M. McKinney is a Chemical Engineer.

"residuum," all of which are tested as indicated in the analytical report. The apparatus and methods used are discussed in detail in a forthcoming bulletin[1] of the Bureau of Mines.

Graphic Interpretation

The curves shown in Fig. 1 are helpful in bringing out the general nature of the crude oil under consideration. The volume-percent curve shows the percentage volumes of the successive fractions and how these fractions are grouped to form the various products listed in the Approximate Summary of the analytical report, whereas the API gravity curve is made up of lines representing the gravities of the successive fractions. Both curves are drawn from data given in the analytical report on the 15 distillate fractions, but, as indicated in Fig. 1, they can be extended to include the residuum. When thus completed, each curve is characteristic of the crude oil it represents.

Comparison of Crude Oil

Although curves of these two types have been used in comparing crude oils, they are less useful in this regard than "Correlation Index" (C. I.)[2] curves. The correlation index is a number whose magnitude indicates certain characteristics of a crude-oil distillation fraction. This index was originally developed to aid in comparing crude oil analyses being used in comparison of crude oil from different stratigraphic locations by the Research Committee of the Tulsa Geological Society.

A study of possible relationships between the boiling points and specific gravities of hydrocarbons showed that, if the reciprocal of the boiling point expressed in degrees Kelvin (°Centigrade + 273.1) was plotted against the specific gravity for the normal paraffin hydrocarbons, a linear relationship resulted. When similar data for other hydrocarbons were plotted on the same basis they did not fall on a single line, but conformed to zones or groups. As a group the iso-paraffins are found adjacent and parallel to the normal paraffins; at higher densities is a zone representing the naphthenes; and at still higher densities are the values for the aromatic hydrocarbons.

The position of the data on this chart indicated that it would be possible to obtain an approximation of the composition of a material having a certain boiling point by drawing lines parallel with the one for the normal paraffins, and using the intercept of these lines on the temperature axis as an identifying number. To further simplify the system, the intercept for the normal paraffin

TABLE 1—Typical Analysis of Crude Oil Sample from TXL Field, Ector County, Texas

TXL field; Ellenberger limestone; 10,790-10,975 ft; Sample 46082; Texas, Ector County, 1-S-Blk. 45

General Characteristics

Sp. Gr., 0.821; API Gr., 40.9°; Sulfur, %, 0.19; Color, greenish black; Saybolt Universal viscosity at 100° F., 38 sec.

Distillation, Bureau of Mines Hempel Method

Distillation at atmospheric pressure, 747 mm.

Fraction No.	Cut ° F.	%	Sum %	Sp. Gr., 60/60° F.	°API, 60° F.	C.I.	Aniline Point ° C.	First drop, S.U. Visc., 100° F.	84° F. Cloud Test ° F.
1	122	3.1	3.1	0.633	92.0				
2	167	3.0	6.1	.654	84.9	—2			
3	212	4.1	10.2	.688	74.2	6.1			
4	257	4.9	15.1	.713	67.0	8.9			
5	302	5.1	20.2	.730	62.3	9.4			
6	347	4.7	24.9	.749	57.4	12			
7	392	6.1	31.0	.764	53.7	13			
8	437	6.0	37.0	.780	49.9	15	68.7		
9	482	6.1	43.1	.794	46.7	16	73.9		
10	527	7.6	50.7	.808	43.6	18	77.3		
Distillation continued at 40 mm.									
11	392	5.7	56.4	0.823	40.4	21	79.9	39	20
12	437	7.1	63.5	.839	37.2	25		43	30
13	482	4.8	68.3	.857	33.6	30		52	40
14	527	4.8	73.1	.876	30.0	36		64	55
15	572	6.2	79.3	.892	27.1	40		125	70
Residuum		20.6	99.9	0.955	16.7				

Carbon residue of residuum, 9.1%; carbon residue of crude, 2.2%.

Approximate Summary

	%	Sp. Gr.	° API	Viscosity
Light gasoline	10.2	0.661	82.6	
Total gasoline and naphtha	31.0	0.714	66.7	
Kerosine distillate	19.7	.795	46.5	
Gas oil	14.0	.835	38.0	
Nonviscous lubricating distillate	9.3	.853–.886	34.4–28.2	50–100
Medium lubricating distillate	5.3	.886–.901	28.2–25.6	100–200
Viscous lubricating distillate				Above 200
Residuum	20.6	.955	16.7	
Distillation loss	1			

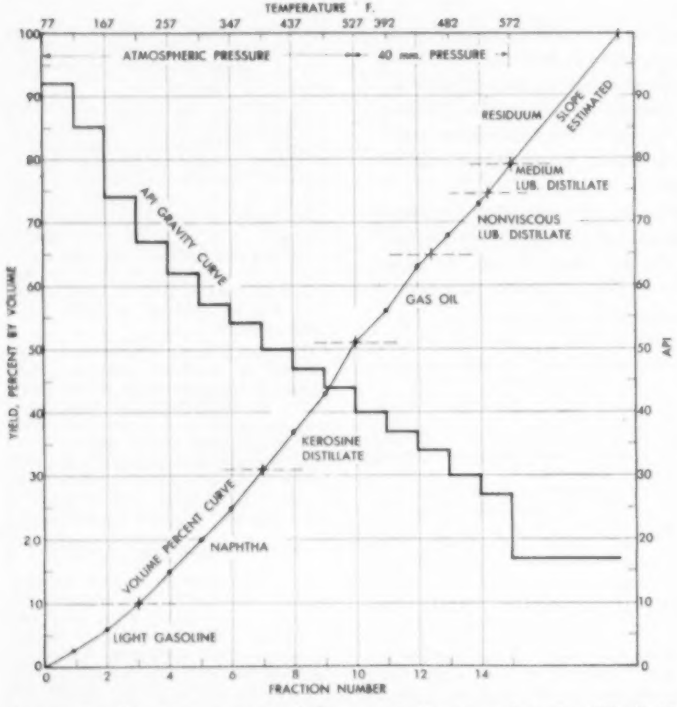


Fig. 1—Graphic representation of Bureau of Mines' analysis for TXL Field (Texas) crude

line was arbitrarily given zero as the index number, and the intercept for the line through benzene an index number of 100. The interval between these two lines included virtually all hydrocarbons usually found in the analysis of crude oil.

This index system can be applied easily to Hempel-analysis data, as each fraction (cut) has a constant average boiling point and an average specific gravity. Therefore, the calculation of this index for each fraction provides an indication of the type of material present, and comparison of index numbers for a series of fractions of two or more oils provides a usable substitute for the more exact qualitative analysis that would be desirable. If a fraction were composed exclusively of normal paraffin hydrocarbons, the value of the index number would be zero. If the fraction be from a paraffin-base crude oil of the usual type, its index will not be zero but will be small, whereas fractions from intermediate and naphthene-base crude oils will have increasingly greater values for the indexes.

The C.I. curves of four light crude oils are compared in Fig. 2; the item numbers referring to the condensed analyses are listed in Table 2. Item (1) also refers to the crude oil whose analysis is given in Table 1. The C.I. curve of this oil indicates that its low-boiling fractions (gasoline) are more paraffinic than the corresponding fractions of any of the other three oils, whereas at the upper end of its distillation range it is more naphthenic than two of the others.

In general, it can be stated that if the C.I. curves of two oils lie close together at all points, the oils are probably similar; but if the curves diverge, as in the present instance, the oils are certainly different.

There are, however, two limitations to the usefulness of curves in the comparison of crude oils. If more than four or five curves are drawn on the same chart, there is difficulty in observing the characteristic shape of any one curve; also, several "general characteristics" are given in the analysis of each crude oil that should be considered in making comparisons in addition to the data included in the curves.

Data for comparison of crude oils can easily be tabulated as shown in Table 2. As already noted, Item 1 in this table is the oil whose analysis is given in Table 1; Items A to J, inclusive, are the 10 oils discussed by Holliman, et al.[3] These 10 oils were selected for comprehensive study in 1945, as at that time they represented a major portion of the crude-oil production of the U. S. They have been included in the present report for comparison, as the detailed studies made of them form the basis of many correlations and conclusions.

Each line in Table 2 is a condensed statement (based on a Bureau of Mines routine analysis) of the essential characteristics of a sample of crude oil, many of which characteristics (particularly those indicated in the headings of Columns 8, 9, 10, 11, and 20) seem to be independent of each other.

Information regarding the source of each oil is given in Columns 2 to 6, inclusive, followed (Columns 7 to 11, inclusive) by figures showing the general characteristics of the oil. These are supplemented by a consolidated percentage summary (Columns 12 to 16, inclusive), followed by two columns of C.I. averages and (Columns 19 and 20) by data showing characteristics of the distillation residuum.

The correlation index is used in this tabulation by computing the average (to the nearest whole number) of the C.I. numbers of Fractions 4 to 7 (see Column 17, Table 2) of each crude oil, as well as a similar average of the C.I. numbers of Fractions 13 to 15, inclusive (Column 18).

The values in Columns 12 to 16, inclusive (consolidated percentage summary), represent a grouping of fractions on the basis of distillation ranges alone, whereas the approximate summary used in the analysis itself takes gravities into account, also. For the comparison of crude oils, the simpler consolidated percentage summary is preferred.

In stating the gravity of the residuum, decimal specific gravity is preferred to API gravity, as many

TABLE 2—Comparison of Crude Oil Analyses

Summary of data showing sources and general characteristics of samples

Item	Sample	State	Field	County	Producing formation and age	Depth, ft.	Gravity °API	Color[1]	Sulfur, %	Viscosity 100° F., sec.	Carbon residue, %
	1	2	3	4	5	6	7	8	9	10	11
(1)	46082	Texas	TXL	Ector	Ellenberger limestone, Ordovician	10790-10975	40.9	G.B.	0.19	38	2.2
A	45040	Penna.	Bradford	McKean	Bradford sands, Devonian	.....	43.6	Green	.11	40	.6
B	45031	Okla.	West Edmond	Canadian	Hunton limestone, Devonian	.....	41.5	B.G.	.14	39	.6
C	45036	Ill.	Louden	Fayette	Bethel sand, Upper Mississippian	1550-1566	38.8	B.B.	.26	45	2.6
D	45032	Texas	Conroe	Montgomery	Cockfield, Eocene	.....	37.8	Green	.12	35	.3
E	45035	do.	East Texas	Rusk	Woodbine sand, Upper Cretaceous	.....	37.8	B.B.	.36	44	2.3
F	45043	Calif.	Coles Levee	Kern	Stevens Zone sand (Lower Western Zone) Miocene	8650-8868	35.0	B.B.	.59	45	3.0
G	45033	Texas	Slaughter	Hockley	Permian limestone	.....	32.3	B.B.	2.07	48	3.7
H	45034	do.	Hastings	Brazoria	Frio sand, Oligocene	.....	31.3	G.B.	.24	48	.9
I	45039	do.	Yates	Pecos	Permian limestone	.....	29.1	D.G.	1.59	64	3.3
J	45042	Calif.	Midway-Sunset	Kern	Etchegoin sand, Lower Pliocene	1600-2100	20.3	B.B.	.88	240	6.0

Summary of analytic l and computed data

Item	Volume percentages Fractions 1-3, inc. (light gasoline)	4-7, inc. (naphtha)	8-12, inc. (kerosine and gas oil[2])	13-15, inc. (lubricating oil[2])	Residuum	Correlation index averages of fractions 4-7, inc.	13-15, inc.	Characteristics of residuum % on gasoline, free basis	Sp. Gr.
	12	13	14	15	16	17	18	19	20
(1)	10.2	20.8	32.5	15.8	20.6	11	35	50	0.955
A	11.2	23.2	24.2	15.9	23.1	21	28	37	.900
B	11.3	22.1	26.2	17.0	21.3	22	34	33	.916
C	12.0	21.5	24.0	16.0	24.4	23	40	38	.958
D	8.0	28.4	41.7	14.6	7.1	40	38	11	.938
E	12.5	21.8	25.5	16.0	22.8	27	40	35	.966
F	10.9	21.3	23.0	17.7	23.4	31	52	36	.989
G	11.8	20.6	24.0	15.0	27.9	32	51	42	.995
H	3.9	15.5	41.1	18.8	20.4	35	51	25	.938
I	4.4	18.2	26.3	16.7	33.5	27	54	44	.966
J	1.1	13.2	25.7	19.5	38.8	36	70	46	1.010

(1) Colors of crude oils in this table are designated as follows: green, no abbreviation; dark green, D.G.; brownish green, B.G.; greenish black, G.B.; brownish black, B.B.
(2) Approximate.

residua are heavier than water (Sp. Gr. 1.00). The values in Column 19 (percentages of residuum on gasoline free basis) have been found useful in showing similarities and differences among crude oils that have been subjected to different amounts of "weathering." These values are obtained by multiplying the percentages of residuum in Column 16 by 100 and dividing by the sum of the values listed in Columns 14, 15, and 16.

In 1941, the Research Committee of the Tulsa Geological Society[4] reported that 80 samples of crude oil collected from Burbank sand production in Oklahoma and Kansas were similar in character. A more recent study of the original analyses of these 80 similar samples, which has been made by the writers of the present paper, indicates that numerical tolerances can be set for many of the characteristics listed in Table 2.

In comparing two oils, the C.I. averages in Columns 17 and 18 should first be considered. For the oils to be classed as essentially identical, only one unit variation (±) can be allowed for each of these averages. If the oils are in agreement on this basis, the characteristics tabulated in Columns 9, 10, 11, 19, and 20 should be considered, using the tolerances indicated in Table 3.

If the oils listed in Table 2 are thus compared, it will be found that they are all different in one or more characteristics. Items F and G are similar in most respects but must be classed as "definitely different" because of the wide difference in their sulfur contents.

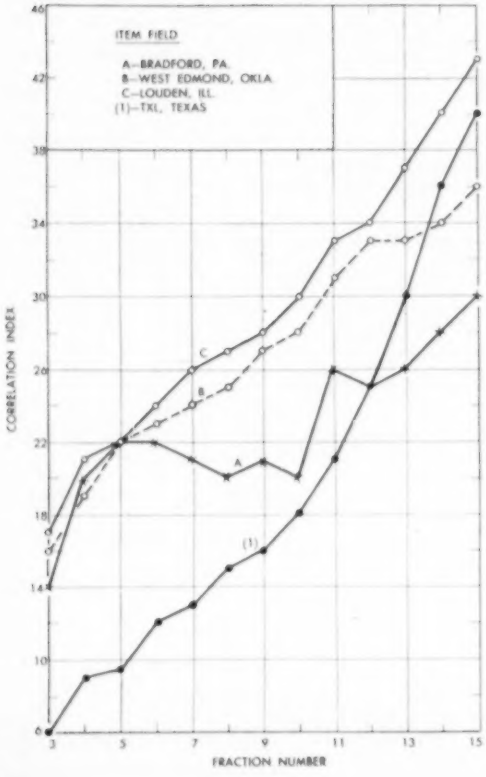
For most purposes, similarities and differences are adequately indicated by the procedures outlined in the preceding paragraphs. For a final check, however, it is well to compare the values given in Columns 12 to 16, inclusive.

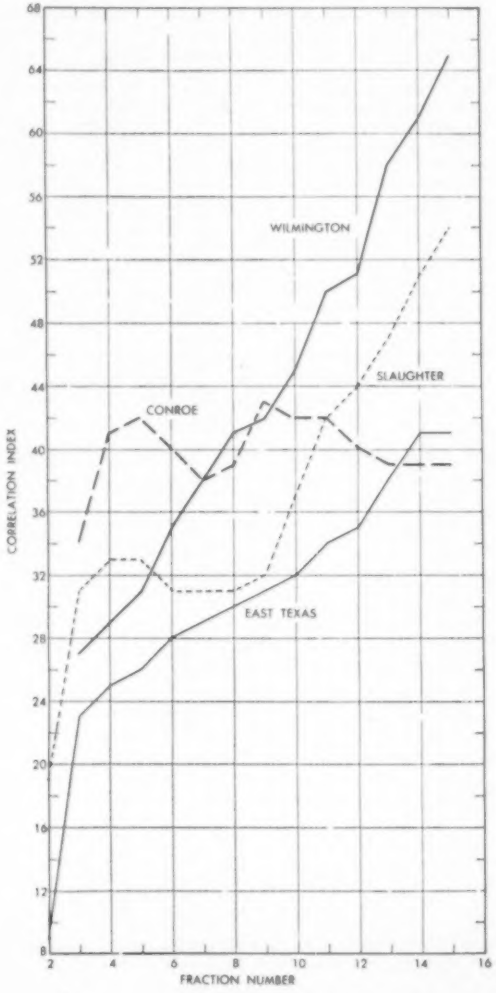
Significance of Properties

Correlation Index: The correlation index[2], because it is inherently based upon the specific gravity and boiling point of the hydrocarbons composing the distillates, often offers a means of ascertaining the approximate composition, or possible use of a distillation fraction. Thus, by studying the correlation index curve for

Fig. 2—Below: comparison of correlation index curves of four light crude oils

Fig. 3—Right: correlation index curves for four light crude oils





the entire crude oil, or by considering the correlation indices of certain fractions, the suitability of the crude oil for the manufacture of aviation-base stock or as a source of toluene, its content of aromatics, and the approximate viscosities of fractions can be determined.

Aviation base stock: During World War II the many studies which the Bureau made of crude oils as sources for aviation base stock were greatly helped by using the correlation index as a screen. It was found that unless Fraction 4 had a correlation index of at least 28, it was ordinarily of no value as a base stock, and usually, unless the correlation index was as high as 30 to 32, it would not furnish any significant quantity of 91-octane material.

Toluene: Another property of crude oils that was important during the war is the content of toluene. It was found that the correlation index was also a good indication when toluene was present. In general, any crude oil whose correlation index exhibits a high value in the vicinity of Fractions 4 and 5 and then decreases between Fractions 5 and 7 contained useful quantities of toluene, provided this index value is 30 or higher. A typical example of this is shown in Fig. 3, where curves for Conroe, Slaughter, Wilmington, and East Texas crude oils are shown. The toluene contents of these oils were determined to be as follows: Conroe, 1.76; East Texas 0.27; Slaughter, 1.46; Wilmington 0.2 (calculated).

If the refractive index is determined on the fractions, as is sometimes done, then the refractivity intercept-specific gravity relationship can be used with certain charts (Fig. 2, Reference 5) to estimate the toluene content with considerable accuracy. Similar relationships can be developed for the benzene content and for the content of C_7 naphthenes.

Viscosity: Viscosity is an important property of jet fuels, Diesel fuels, and lubricating oils. In the case of jet fuels, the viscosities at −40 and 100° F. are important, and correlations have been developed[3] depending on specific gravity, boiling point, and correlation index, which permit estimation of these viscosities with considerable accuracy for any fraction from No. 4 through No. 10. Similar data can be established for Fractions 11 through 15, but with somewhat more error, particularly in the heaviest fraction. The viscosity of blends of consecutive fractions also can be estimated[3] fairly successfully.

Aromatics: A method for the determination of aromatics, which is applicable to distillates such as those that will be used for jet fuels, for example, is based on two factors: 1—The relatively high specific gravity of aromatics with respect to paraffins and naphthenes, with approximately equal boiling points, and 2—the occurrence of an "aromatic hump" in the correlation index curve mentioned above. Technical Paper 722[3] discusses this method of determining aromatic content in detail and gives comparisons with actual aromatics as determined by silica gel analysis.

TABLE 3 — Allowable Variations in Similar Crude Oils

Column	Characteristic	Allowable Variation (±), %
9	Sulfur	10
10	Viscosity	10
11	Carbon residue	25
19	Percentage of residuum on gasoline free basis	10
20	Sp. Gr. of residuum	1

Boiling range: It is often necessary to estimate the boiling range of a gasoline fraction, for example, on the basis of the routine analysis. Correlations that enable this to be done have been developed and are presented in Technical Paper 722[3] in which a method applicable to gasoline and another method applicable to kerosine, light gas oil, and jet-propulsion fuel are discussed.

Sulfur: One of the important requirements in modern specifications for fuels and lubricants is the content of sulfur. The routine analysis given in Table 1 indicates only the sulfur content of the crude oil. However, experimental data indicate that the sulfur is distributed rather uniformly throughout the crude oil, increasing with boiling point. There appears to be some variation, depending on the type of crude oil, and correlations have been developed[3] that permit estimation of sulfur in blends and fractions with considerable accuracy.

Specific gravity: Specific gravity enters into many of the calculations and correlations that have been mentioned. In addition to those already discussed, a correlation using specific dispersion, when refractive-index data are available, can be developed[3] for the aromatic content of the fractions and blends from a routine analysis. This method compares favorably with the gravity-correlation index method discussed above.

Aniline point: Aniline points, of course, are useful in conjunction with Diesel-fuel characteristics, especially estimation of cetane number. Technical paper 722[3] proposes a method whereby the aniline point of blends of fractions can be estimated from the aniline point of the fraction, and further by determining the volumetric blending aniline point for paraffins, naphthenes, and aromatics, it was possible to set up equations from which the aniline point of fractions could be calculated with good success. This permits the calculation of aniline points for analyses made prior to the time the Bureau began to include aniline points as a property.

Utilization Possibilities

In studying the possibilities of utilization of a crude oil, it is necessary, of course, to take into account the market demand for particular products and the availability of the refinery equipment needed to

Meet the Authors

N. A. C. Smith

H. M. Smith

N. A. C. Smith was Supervising Engineer of the Bureau of Mines Petroleum Experiment Station in Bartlesville, from 1926 to 1945. At his own request he was relieved of administrative duties and is now engaged in technical writing on special assignments. He was born in Massachusetts and graduated from Clark College with a B. S. degree in chemistry in 1909.

Harold M. Smith is principal petroleum chemist in charge of the chemistry and refining section at the Bureau of Mines Petroleum Experiment Station, Bartlesville. Born in Rhode Island, he received his education in Massachusetts, being graduated by Clark College in 1922 (B. A., A. M.) in chemistry. In 1923 he joined the Bureau of Mines.

C. M. McKinney is in charge of crude oil evaluation work at the Petroleum Experiment Station. He is a native of Oklahoma and received a B. S. degree in petroleum engineering from Oklahoma University in 1940. He joined the Bureau at Bartlesville in 1942 and from 1944 to 1945 was assigned to the Bureau's Washington office. He served as a Lieutenant (j. g.) in the Navy from 1945 to 1946 and returned to Bartlesville in 1946.

manufacture them, as well as the probable yields and qualities of the products as indicated by an analysis of the oil. The crude-oil analysis, furthermore, should be considered as a whole and all of the probable products studied; not only as individuals, but in their relationships to each other.

However, this last requisite is beyond the purview of the writers, as this would require a knowledge of refinery equipment, capacities, and other factors that vary from refinery to refinery, and an evaluation for one plant would not be suitable for another. The refiner must decide which products are most suited to his particular application and which combination would give him the most economical over-all processing results.

With this thought in mind, the possibilities of the T.X.L. crude oil will be discussed under a number of different product headings, illustrative of the treatment to be given other crude oils in subsequent articles of this series.

Aviation base stock: As indicated earlier in this article, unless the correlation index of Fraction 4 is at least 28, and preferably higher, the possibility of preparing straight-run aviation base stock is nil, and therefore it can be concluded that this particular crude oil would be unsuited for this purpose.

Motor gasoline: It is obvious from the data in Tables 1 and 2 that a fairly good yield of straight-run gasoline can be obtained from this crude oil. It is also obvious from the low C.I. values, that the octane number will be too low to meet present standards.

ASTM specifications[6] provide for several grades of gasoline having different boiling ranges. Type A, having a 90% point of 392° F., and Type B, having a 90% point of 356° F., represent the two most common types. Using the data given in Technical Paper 722[3] it appears that about 39% of Grade A gasoline and about 34% of Grade B gasoline could be prepared from this crude oil.

However, as mentioned above, they would be unsatisfactory from an octane number point of view and would have to be improved by blending with either cracked material or synthetically prepared high-octane blending stock. The sulfur content of the gasoline should be low and probably would not cause any trouble, although some of the Ellenberger production is reputed to have an unusually high proportion of volatile mercaptans, even when the total sulfur content is low.

Solvent naphthas: The low correlation indices of the naphtha fractions indicate the virtual absence of aromatic and other undesirable components so far as an aliphatic solvent is concerned. For example, Stoddard solvent probably could be manufactured from this oil by simple treating methods, and other aliphatic solvents of narrow boiling range probably could be prepared successfully.

Kerosine: As was the case for the solvent naphthas, the high paraffinicity (low C.I. values) of this oil indicates it should be a good source of kerosine, and probably 15 to 20% of high-grade kerosine could be prepared with a minimum of treating.

Diesel fuel: The yield of Diesel fuel from this oil probably would be limited by the pour point required of the finished product. It appears that approximately 50% of the crude oil could be used as a Diesel fuel within the boiling range of 300° F. initial boiling point to 675° F. 90% point and provide an estimated cetane number, based on aniline point, density, and boiling point, of approximately 65.

However, this fuel probably will have a rather high pour point and would have to be undercut, with subsequent decrease in yield, if application were for areas where a low-pour-point oil was required. The 50% yield mentioned would correspond to a No. 2-D oil, according to the ASTM specifications for Diesel fuels[8]. By undercutting to give an end point of 625° F., a somewhat smaller yield of No. 1-D Diesel fuel could be prepared with possibly some decrease in cetane number.

Fuel oil: It is obvious that this crude oil should provide excellent fuel oil if this part of it is not used for Diesel fuel or for cracking stock. It should be a source of fuel oil of almost any grade from 1 to 5, as given in ASTM specifications[9], depending on the refining process used.

Jet engine fuel: This crude oil could provide a large yield of jet engine fuel were it not for the wax content. However, it is believed that the cloud tests of 20° and 30° F. for Fractions 11 and 12, respectively, in conjunction with the unusually low C.I. values up to this point, indicating extreme paraffinicity, means that the complete boiling range of jet fuels could not meet the required −76° F. freezing point. Further, so much undercutting might be necessary to meet the freezing-point requirement that the resultant fuel could not meet other jet fuel specifications[10]. Portions of it obviously could be used for jet-fuel purposes.

Lubricating oil: Although the distillation analysis shows the presence of stock in the lubricating-oil boiling range, the specific gravity of these fractions, in comparison with crude oils that are known to yield good lubricating oil, would indicate that the TXL crude oil is probably not well adapted for the manufacture of lubricants, and the material in this boiling range would find better outlet as a fuel oil or as a cracking stock.

Asphalt: Stanfield and Hubbard[11] report the preparation and examination of asphalts from 24 crude oils and, as a basis for comparison, estimate the yield for each crude oil of 100-penetration (at 77° F.) asphalt. A study of the original analyses of these crude oils shows that there is a fairly constant ratio between the carbon residues of crude oils and their yields of 100-penetration asphalts. The average ratio for the 25 crude oils is 4.9; that is, a carbon residue of 2.2% for the TXL crude oil indicates 100-penetration asphalt content of about 11%.

Utility of Analyses

The above discussion should be helpful to refiners and others who are interested in studying crude-oil analyses and indicates the kind of data that can be provided by the routine crude-oil analysis of the Bureau of Mines. These analyses have been published since 1920 and are all comparable, as they have been made by the same method, under the same conditions, and in identical apparatus. Although they do not provide all of the information necessary with regard to identification or evaluation of a crude oil, they can yield important data if studied carefully. The following articles in this series will discuss general characteristics and usefulness of the crude oils produced from important areas in the U. S. in the light of the background presented in this article. The next article will cover crude oils from Scurry County, Texas, and adjacent areas.

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Wartime Toluene Plant Converted To 50,000 b/d Topping Unit

By W. L. BASS, Process Engineer, Rust Process Design Co.
and V. E. SMITH, Vice-President, Petrol Refining, Inc.

Engineering and construction problems are described in the job of using salvaged equipment from a toluene extraction plant to erect two crude oil topping units with a combined capacity of 50,000 b/d at a new location 90 miles distant from the original site. The fractionators were adapted from the toluene unit azeotropic towers by relocating trays to provide stripping sections, adding draw-off pots for side streams, adding new nozzles, and removing the reduced diameter top sections.

Other equipment utilized included two gas-fired oil heaters along with most of the refractory brick, heat exchangers, pumps, valves and fittings, pipe, instruments, structural shapes, and the like. Overall costs were in line with the original estimate and confirmed management's belief that substantial savings could be realized in comparison to a new installation.

AN earlier article[1] described the steps taken by Petrol Refining, Inc. in adapting their recently acquired refining facilities at Texas City, Texas to peacetime operation. These facilities, consisting principally of a Houdry fixed bed catalytic cracking unit, were originally set up to charge purchased reduced crude. The prevailing high price of reduced crude, however, made it imperative to substitute crude oil as a charge stock since this was more readily available at a favorable price. By an ingenious rearrangement of existing equipment, the Houdry unit was modified to permit simultaneous crude oil topping and cracking.

While this expedient effectively accomplished the purpose of keeping the refinery on stream, refinery management recognized it as a "temporary solution" and initiated plans for erection of new crude oil topping units. These plans were culminated in the fall of 1948 with the letting of a contract to Rust Process Design Co., subsidiary of Rust Engineering Co., Pittsburgh, for the design and erection of two crude oil topping units with a combined capacity of 50,000 b/sd. Simultaneously, a wartime toluene extraction unit located at Beaumont, Texas, was acquired from War Assets Administration with the expectancy that this unit would provide most of the equipment for the new crude units at a considerable savings in time and money.

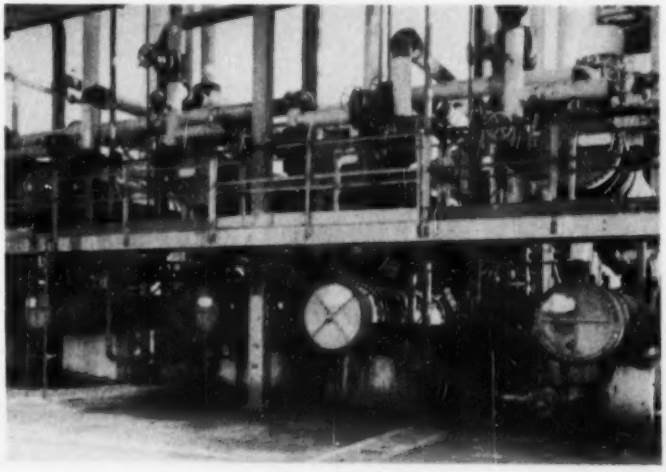
The following reports on the engineering and construction problems encountered in this conversion and relocation at a plant site some 90 miles from the original installation.

The Beaumont plant, installed during the early part of the war, was designed to recover toluene from selected refinery streams by methanol azeotropic distillation. The plant comprised two feed preparation sections for preparing toluene concentrates, an azeotropic distillation section, a section for recovery of solvent and an acid treating section for purifying the recovered toluene.

Although located adjacent to the refinery of the Magnolia Petroleum Co., wartime operators of the plant, the toluene plant was set up to be substantially independent of the main refinery. Two oil field boilers furnished steam required for processing and pumping, with the majority of the pumps motor driven. A cooling tower and circulating water system on the property furnished cooling water for condensers and coolers. Heat for tower reboiling was obtained from a hot oil belt, in which gas oil was circulated through two gas fired heaters.

The toluene unit was operated for 21 months by Magnolia and shut down in 1945 due to an overabundance of toluene supply. On its shutdown the plant was put in standby condition and remained so until its acquisition in September 1947 by Petrol. An inspection of the plant by Universal Oil Products Co. in July 1946 indicated all equipment to be in fair condition.

The primary requirements of the



Right: close-up view of a portion of the heat exchanger area rebuilt from equipment previously used in toluene extraction plant

new topping facilities were set up as follows:

1—Two units to be provided to permit separate processing of crudes of varying characteristics.

2—A combined crude capacity of 50,000 b/sd, split as nearly equally between the two units as practical.

3—Sufficient flexibility to handle the wide variety of Venezuelan and Texan crudes available to Petrol on the open market.

4—Ability to prepare marketable distillates and a reduced crude suitable as Houdry feedstock.

5—Maximum adaptation and reuse of equipment and material available from the Beaumont plant to minimize new purchases.

As is generally the case with conversion jobs, considerable trial and error was involved in obtaining a satisfactory match between new requirements and existing equipment capacities and specifications. Numerous processing schemes were studied and abandoned because of extensive equipment changes, poor operating flexibility, expected high maintenance or other reasons.

The final design, shown diagrammatically in Fig. 1, satisfactorily met all of the conditions outlined above. As will be evident from this flow sheet and the accompanying photographs, the completed units are in every way comparable with other modern topping units, designed without the restrictions of adapting available equipment. This result was achieved without any major equipment revisions or new equipment purchases.

Towers

Crude fractionators for the topping units were adapted from the toluene unit azeotropic towers, the largest available on the job. Use of these towers, respectively 10 ft.-6 in. x 11 ft.-6 in. diam., was made possible by the judicious use of back pressure and intermediate reflux to reduce vapor traffic in the top sections of the towers. The total crude throughput of 50,000 b/sd was split between the two units in accordance with the fractionating capacities of these towers, with 22,000 b/sd to the smaller and 28,000 b/sd to the larger.

Fig. 1—Flow sheet showing arrangement and final design of two-unit crude topper as built from equipment salvaged from wartime toluene plant

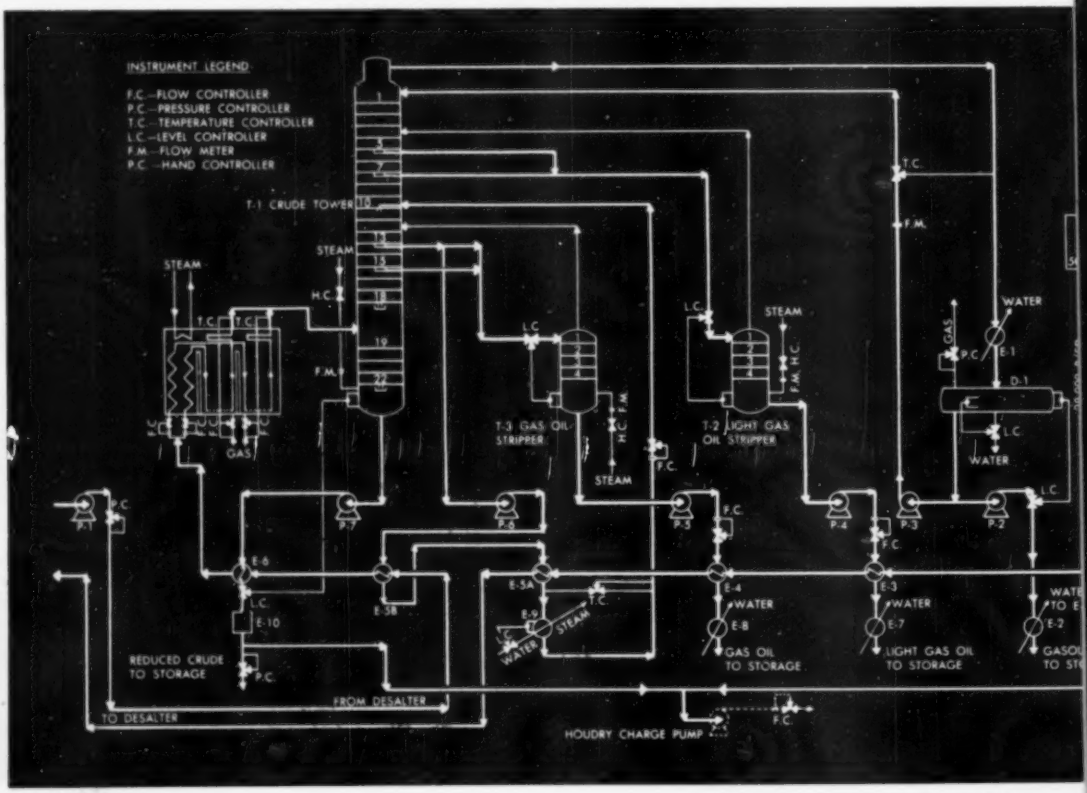
Physical changes to the towers consisted of relocation of trays to provide stripping sections, addition of draw-off pots for side streams and addition of nozzles as shown in Fig. 2. The reduced diameter top sections were removed as indicated since they were unnecessary in the new design and offered a potential spot for corrosion.

Sidestream strippers for both units were adapted from horizontal reflux drums, upended and furnished with new alloy trays.

Heaters

Two end wall gas fired 90,000,000 Btu/hr. oil heaters were available at Beaumont. Each heater contained two separately fired radiant chambers connecting through a plenum chamber to a single convection section. All tubes were hot finished seamless carbon steel, 6 in. I.P.S. x 0.28 in. average wall x 36 ft.-0 in. long, fitted with Key type return fittings and arranged in two all series parallels per heater.

In order to adapt these heaters to crude service it was necessary to



"open up" the tube arrangement to accommodate the increased vaporization without excessive pressure drop. This was accomplished by additionally paralleling for several passes the outlet tubes in each radiant chamber. This rearrangement provided two balanced low pressure drop parallels, independently controllable on both process and firing sides. A portion of each convection section was removed from oil service and repiped as a steam superheater to provide steam for sidestream stripping.

A number of new multi-hole Key fittings were purchased to effect these changes in tube arrangement; this being the only new material required for adapting the heaters to their new service.

Heat Exchangers

The selection of suitable heat exchangers from those available at the Beaumont unit proved to be one of the most difficult portions of the new design. Although a large number of units were available, these had for the most part been in condensing or reboiling service and had very little or no shell baffling. Their use in liquid-liquid service required either extensive rebaffling or the use of oversize units to compensate for low shell side heat transfer coefficients.

A careful economic comparison was made of the cost of rebaffling small units against possible increased maintenance on the oversize units, resulting in the decision to use the larger units. Accordingly, units were selected in which the only modifications required were the relatively inexpensive ones involving changes in nozzle sizes and channel partitions. For reduced crude cooling new coil in box units were assembled from available pipe and return bends.

All shell and tube units were shipped to a nearby shop, disassembled and inspected and the necessary modifications made. The completed units were shop reassembled and pressure tested before delivery to the Texas City job site.

Pumps and Drives

Three-pump hook-ups, consisting of one operating pump for each crude unit and a common half spare, were employed for each pumping service. The bulk of pump and driver requirements were met by equipment from the Beaumont unit, although it was found necessary to purchase several new pumps for hot service. Characteristics of the existing pumps were reviewed and, in some cases, changes in impellers made to better fit them to the new services.

In addition to the major equipment discussed above, much of the auxiliary equipment and material required for the new units were also obtained from the Beaumont unit. This included almost all of the instruments, control valves and electrical fittings and a substantial part of the pipe and fitting requirements. Lesser portions of pipe insulation, structural shapes, platform gratings, handrails and the like were also salvaged.

Re-use of this material required careful attention to small details and constant and close collaboration of engineering, procurement and field activities. At an early stage in the engineering, specifications and bills of materials of the new requirements were prepared. By sifting through the records of the Beaumont plant, selections were made of existing equipment which would fit the new services. These material lists were

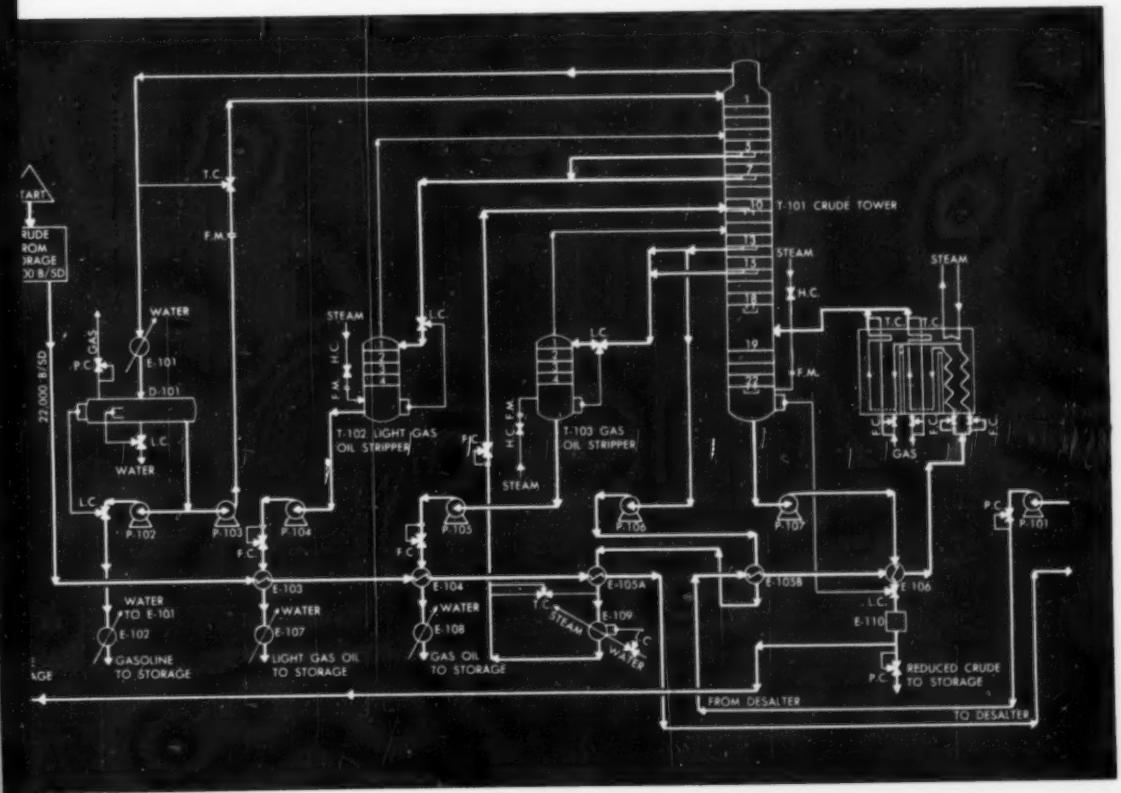


TABLE 1—Typical Operations—Topping Blended Crudes, No. 2 Unit—22,000 b/sd Design Throughput

Operation		A	B	C
Crude Charge	b/sd	21,500	23,914	25,600
	° API	35.9	34.1	36.8
Gasoline	Vol. %	27.8	25.3	30.2
	IBP	100	98	96
	10%	170	162	148
	50%	254	252	244
	90%	326	327	331
	E.P.	370	372	372
Light Gas Oil	Vol. %	14.0	19.5	14.4
	IBP	365	360	345
	10%	395	388	395
	90%	466	482	470
	E.P.	486	506	490
	Flash	151	141	140
Heavy Gas Oil	Vol. %	7.0	18.2	20.4
	IBP	490	470	375
	10%	510	516	490
	90%	544	666	602
	E.P.	572	716	648
	Flash	230	230+	182
Reduced Crude	Vol. %	51.2	37.0	35.0
	IBP	450	450	390
	10%	576	620	600

periodically revised and brought up to date as the engineering became more definitive and as inspection reports became available from the field.

To minimize field costs only the equipment and material scheduled for re-use was dismantled, the remainder being left in place. Dismantling of the large towers was carried out in a conventional manner with a guyed derrick. All sectional cast iron tray parts were removed prior to letting the towers down to reduce handling load and to avoid breakage. Piping was flame cut into lengths of convenient size for refabrication at Texas City. Exchangers were shipped to a nearby shop for reworking and testing as previously noted.

The two heaters were completely disassembled and the pieces carefully matchmarked to facilitate subsequent re-erection. Tubes were removed in nests, separated from each other by flamecutting the outer tubes of each nest. By positioning these cuts as close to the return fittings as possible enough tube length was left behind the tube sheet to permit rerolling without the loss of a single tube or fitting. With the exception of the hearth brick which was common firebrick all of the refractory was re-used. To reduce breakage the bricks were packed into cartons directly on removal from the furnace settings and moved out of the furnaces by sliding on wooden chutes. Indicative of the effectiveness of this handling procedure is the fact that there was less than 10% breakage in the combined dismantling snipping and erection operations.

Simultaneously with the dismantling of the Beaumont unit, a construction crew was at work preparing the new site at Texas City. Piling was driven and foundations poured at an early stage to permit continuity of erection once the flow of material was started. Deliveries, both of revised material from Beaumont and new material purchased outside, had to be carefully scheduled with the erection program because of limited storage space and access at the new Texas City site.

All re-used material was thoroughly inspected and, where necessary, reconditioned before installation. The cast iron tray parts for the crude towers, pipe and fittings were wire brushed and air blown to remove rust and scale. Towers and drums were built up with weld metal in spots where corrosion was severe. Valves, instruments, exchangers and pumps were completely disassembled, reconditioned and tested before use.

The merits of this reconditioning were apparent when the units were started up. Except for the minor mechanical adjustments invariably required in starting up a new facility, the units came on stream without incident. Operation has been smooth and efficient at throughputs as high as 20% above design rate and both units have demonstrated unusual flexibility in handling wide variations in charge stocks and rates. Table 1 summarizes operating results obtained on the No. 2 unit (designed for 22,000 b/sd crude) in several typical operations.

Overall job costs were in line with the original estimate and confirmed management's belief that substantial savings could be effected in comparison with a new installation.

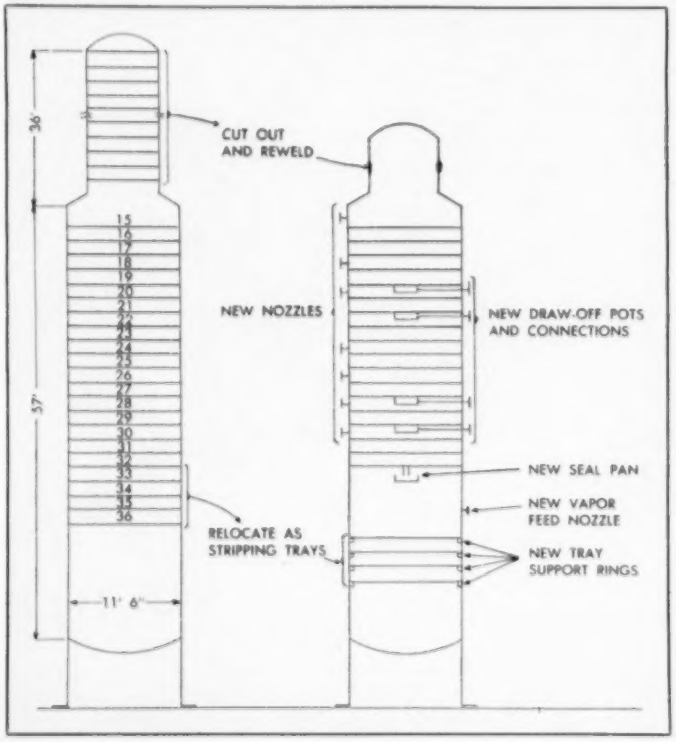


Fig. 2 — Right: indicated physical changes to azeotropic towers from toluene unit as converted to fractionators for the new crude unit

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Evaporation Losses Are Cut over 50% By Using New Dome-Type Tank Roof

By WILLIAM C. UHL
Equipment Editor

EVAPORATION losses from gasoline storage have been reduced over 50% by use of a new vapor-saving storage tank roof at the Worcester, Mass., pipe line terminal of Socony-Vacuum Oil Co., Inc., according to records maintained during the first year following its installation.

The 17,000 bbl. tank is a cone-roof type employing a flexible, balloon-like membrane enclosed in a hemispherical dome. Called a "Vapordome," it was designed and built by Chicago Bridge & Iron Co. at the Worcester terminal in March, 1949. A summary of product movement and vapor losses in this tank and its predecessor is given in Table 1. Average annual net losses for the three-year period preceding the installation were 38,381 gals., or 0.33% of total throughput. Average net losses for a 10½-month period following the installation were 16,069 gals., or 0.15% of the throughput.

The tank, 50 ft. in height x 48 ft. in diameter, is essentially a standard cone roof welded tank with a 30-ft. diameter hemisphere mounted on a skirt plate 4 ft. above the top angle iron. It is illustrated in the cutaway view in Fig. 1 and the cross-sectional drawing, Fig. 2.

There is a circular girder supported by three columns on a 16½-ft. radius, concentric with the tank shell. The circular girder supports the short rafters on which the cone section of the roof rests. The circular skirt is attached to this girder. On top of the skirt is mounted the hemispherical dome constructed of ¼-in. steel plates on 16-ft. spherical radius, without structural members. The design results in the section of the tank under the dome being unobstructed by any columns or stiffening members.

At the junction of the skirt plate and the dome is the attachment for the hemispherical vapor-proof membrane. Just above the point of junction between the membrane and dome roof, four 1-in. drain pipes are installed to prevent accumulation of condensate on the top of the membrane.

The membrane is made of a material called Paracril, weighing 43 oz./sq. yd. Paracril is nylon treated with perbunan, a synthetic rubber compound. The diaphragm is shaped to hemispherical form to match the steel dome of the tank. It has a volume capacity of 14,000 cu. ft. between the extreme high and low positions. There is no support or counter balance for the diaphragm—it rises and falls with the movement of vapor within the tank. Attached to the mid-

TABLE 1—Vapor Loss Record at Worcester Terminal

Year	Roof Area Sq. Ft.	Throughput Gals.	Net Loss Gals.	% Net Loss
1946	1434	12,598,696	46,228	0.37
1947	1434	11,419,200	27,875	0.24
1948	1434	10,403,640	41,041	0.39
Average	1434	11,473,830	38,381	0.333
4-1-49 to 2-15-50	1962	10,712,356	16,068	0.15

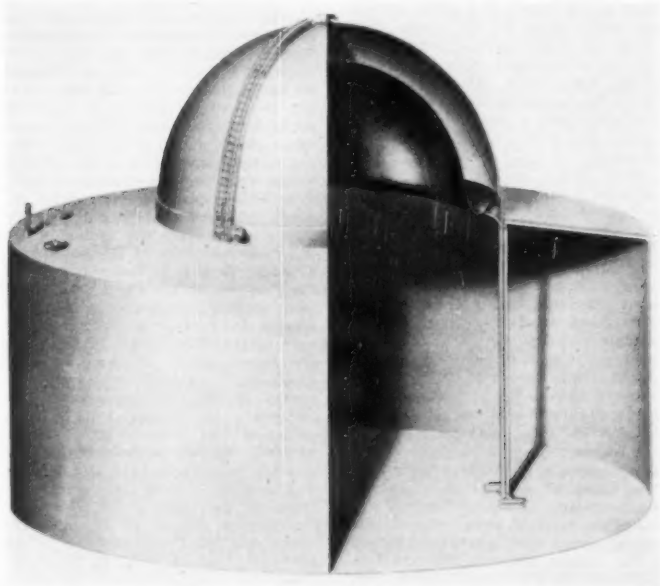
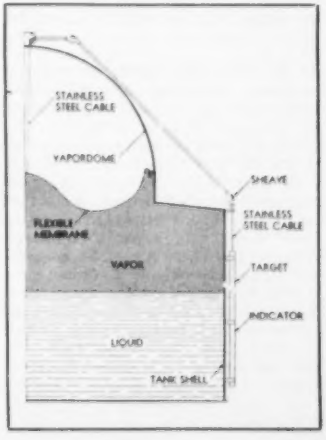
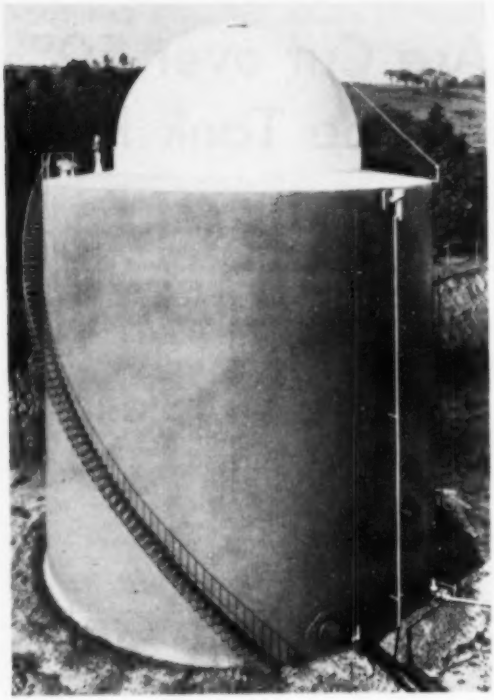
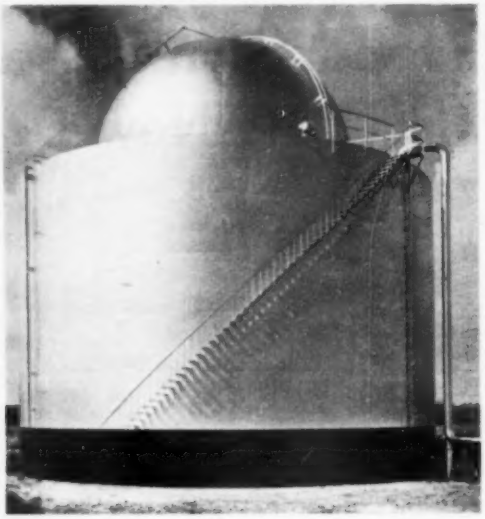


Fig. 1—Left: cutaway view illustrates general construction of new vapor-saving tank roof

Fig. 2—Below: cross section showing installation of diaphragm position indicator







Two installations of Vapordome roofs in petroleum terminals for storage of gasoline products. Left: Socony-Vacuum's 17,000-bbl. tank at Worcester, Mass., was first of its type in this country. Above: Continental Oil's 20,000-bbl. tank at Galena Park, Texas, using similar design for roof

point of the membrane is a cable which passes through the top of the steel dome and then to the ground where a gage provides determination of curtain position.

At the top of the dome there is a hinged manhole cover which incorporates a screened vent to allow free passage of air, as required by the displacement of the membrane.

On the cone roof, close to the stair platform, are two 8-in. vent nozzles equipped with vacuum and pressure relief valves. A Shand & Jurs, Model DLB gage is provided so there will be no vapor loss during gaging and sampling operations. A low pressure manometer is mounted on the roof in this general area to indicate the pressure inside the vapor space, which is considerably under one oz./sq. in.

A tank with a Vapordome roof may be operated as an individual unit or it may be connected by vapor lines to the vapor spaces of one or more adjacent tanks with fixed roofs, the manufacturer states. When connected with other tanks, the Vapordome roof must be of sufficient capacity to handle the expansion of the air-vapor mixture in all tanks in the system. The interconnection makes it possible for vapor to flow from any one tank to any other when various tanks are being filled and emptied simultaneously. This balancing action prevents vapor losses which otherwise occur when some of the tanks in a given system are being filled at the same time others are being emptied, without using any of the vapor storage capacity of the Vapordome. Any reserve capacity not required to accommodate breathing then is available to reduce losses resulting from unbalanced pumping.

From Fig. 1 or Fig. 2, it will be apparent that when the tank is nearly full of liquid the membrane will float on the liquid surface when deflated, and a segment of the sphere will be ineffective in providing vapor storage capacity. This, however, is not detrimental because the amount of thermal breathing from the full tank is reduced and the entire capacity of the Vapordome is not required. The reduction in expansion capacity due to the membrane's riding on the liquid need not exceed one-third of the total capacity.

A recent inspection by Socony-Vacuum engineers, in which air sampling was made at several points above the membrane, indicated that no hydrocarbon vapors were present, attesting to the non-permeable qualities of the curtain material. The vents to the vapor space normally open during and after receipt of product, especially during warm weather. However, they rarely vent at any other time.

The company plans to connect the vapor spaces of other gasoline tanks at Worcester to the Vapordome tank to take full advantage of the potential storage loss reduction offered by this new type of conservation equipment. Present total storage capacity at the terminal is 123,000 bbls. in 17 tanks of various sizes. Most of the stocks are received by pipe line from the company's refinery at East Providence, R. I., with some minor shipments by transport from East Providence and from East Boston, Mass.

A Vapordome tank of similar design but somewhat larger capacity was also installed last Spring by another oil company in the Southwest. Chicago Bridge & Iron erected for the Continental Oil Co. a 20,000 bbl. tank with a Vapordome roof at the Galena Park transport terminal just east of Houston, Texas. In this case, the vapor spaces of three existing, 10,000-bbl. cone roof tanks were connected to the new vapor-saver.

Storage at Galena Park is for premium and housebrand gasolines, shipped in by barge from Continental's refinery at Lake Charles, La. Products move from Galena Park by tank car and tank truck. Based on the present volume of business, the tanks are filled and emptied on an average of about 10 to 12 times per year.

Automatic Process Systems Require Careful Selection of Control Valves

By JOHN PROCOPI, Application Engineer, Brown Instrument Co.
(Minneapolis-Honeywell Regulator Co., Industrial Division)

A control valve can, for several reasons, be placed in the same category as a precision industrial instrument. It is as important a component of any automatic process installation as the control instrument which governs its operation.

The discussion is concerned chiefly with the most widely used control valve, the diaphragm motor-operated type, covering the factor of valve characteristics as affected by inner valve design. Recommended materials of construction for various services are given. Formulas are presented for using the so-called flow coefficient method of valve sizing.

DESPITE the wide application in industry of the many types of control valves, little information has been made available which would assist users in determining the correct valve to select for a specific installation. To properly apply a control valve, it is necessary to recognize its capabilities and limitations—to know what it can do and how.

A control valve may be described as a variable resistance in a fluid flow system. In any automatic control installation, it is as important a component of the system as is the control instrument. It must be capable of performing in accordance with the dictates of the controller, otherwise the installation will be unsatisfactory.

Popular types of control valves are pneumatic, hydraulic, electric or manually operated. Since the pneumatic or diaphragm motor-operated valves are much more widely employed than other types, this article is limited to design and construction features which should be considered in selecting the diaphragm motor control valve.

Power Unit

Basically, the valve assembly comprises a power unit or diaphragm motor and the control valve body. Two types of penumatic operated power units are commonly employed, namely the spring opposed and the springless diaphragm motor.

Spring Opposed Diaphragm Motor:

This power unit (illustrated in Fig. 1) has a flexible diaphragm with a pressure-tight chamber on the upper side; to this, the air output of the controller is connected. A compression spring assembly is coiled on the under side of the diaphragm. A stem connects the diaphragm plate to the valve disc. Air pressure applied to the top of the diaphragm creates a force equal to the product of air pressure mutiplied by the area of the diaphragm. As the diaphragm moves downward, the spring compresses and creates an opposing force which, when equal to the downward force results in a balanced position of the diaphragm and consequently valve disc.

In the design of the diaphragm motor, certain fundamental principles must be followed. As the spring opposes the air loading pressure, it is desirable that a uniform increment of valve travel or lift be obtained from the energy expended. In other words, the ideal curve when plotting air pressure on the diaphragm member versus inner valve movement is a straight line. This characteristic is essential to satisfactory control, to cause uniform variance of inner valve position with changing loading pressures. The design characteristics also should be such that a minimum of friction is introduced.

Closely allied to friction is the characteristic referred to as hysteresis. This may be defined as the difference between the valve stem position, resulting from an increase in air pressure to a given value, and that resulting from a decrease in air pressure to the same value. It is plotted over the entire range of air pressure and stem travel as two curves which form a closed loop. Excessive friction produces a wide hysteresis loop due to the inability of the control valve to reproduce a given position when the same pneumatic loading pressure is reproduced on the diaphragm.

Details Must Be Watched

There are numerous details of design and construction which must be closely watched if hysteresis in a control valve is to be kept at a minimum. Springs must be well made and carefully selected. Diaphragm material should be as flexible as possible consistent with strength and durability. Machine and assembly work must be of the highest caliber in order to eliminate any chance of binding and sticking outside of the stuffing box.

In an automatic control system, the phenomenon of cycling or hunting may be a manifestation of a wide hysteresis loop. For example, if

MEET THE AUTHOR

Mr. Procopi

John Procopi, application engineer with Brown Instrument, was born in New York City in 1918. He was graduated from Columbia University in 1946 with an A. B. in chemistry, and did graduate work at Temple and Pennsylvania Universities in high polymers. He sandwiched four years of active duty with the armed forces between his junior and senior years at Columbia.

Following a two-year period of industrial research in vinyl polymerization at Publicker Industries, Philadelphia, Procopi became associated with Brown. He makes his home in Philadelphia with his wife and two children. He has been an active member of the American Chemical Society since 1947.

the area of the diaphragm is 100 square inches and the applied air pressure is 7 psi., a total force of 700 lbs. acts downward on the valve stem. This force compresses the spring until equilibrium is reached by an equal and opposite reaction and the inner valve comes to rest.

Now assume that the instrument calls for a new valve position, which position would be obtained by an air pressure of 7.25 psi. This extra 0.25 psi. gives an additional total applied force of 25 lbs. on the diaphragm. It is conceivable that a 25 lb. opposing force exists in the form of friction in the stuffing box and valve superstructure. In such a case, the valve fails to reach the position called for by the instrument and the controlled variable continues to rise until the instrument raises the air pressure high enough so that the total applied force on the diaphragm overcomes the frictional force. This, of course, causes the valve to jump to a new position which is beyond that required for control, and the result is cycling or hunting.

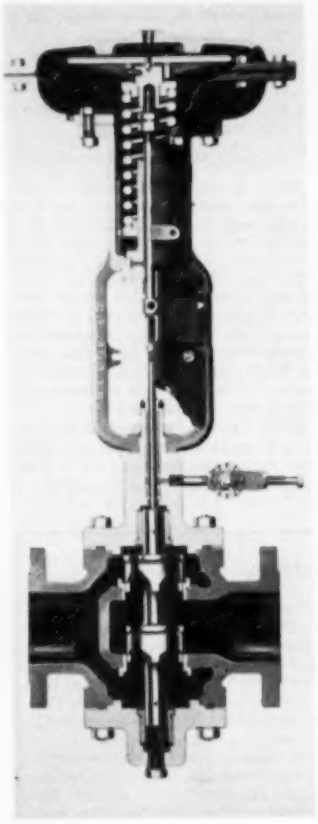


Fig. 1—High lift diaphragm motor valve (double-ported)

Springless Diaphragm Motor:

In the spring opposed diaphragm motor, just described, the spring is required to coordinate the valve position with the instrument air pressure, but while functioning, it absorbs the power provided by the diaphragm motor and leaves little power available to overcome the unbalance in the valve. In certain types, such as Saunders Patent, single-seated and butterfly valves, a high differential pressure across the valve results in a large stem thrust or unbalance. This must be overcome by the diaphragm motor. There is available for this application a springless diaphragm motor (Fig. 2) whose power is a direct function of effective air pressure and diaphragm area.

The power-absorbing spring is eliminated in this motor and the underside of the diaphragm is loaded pneumatically with a constant air pressure which can be adjusted to suit conditions. The top is loaded automatically, through a force balance type of valve positioner, to any pressure required to hold the position dictated by the control instrument. The loading on one side or the other (depending upon the direction of the thrust) can be set at a minimum, thereby making maximum differential pressure available, across the diaphragm, for overcoming thrusts. For example, if the pressure on the underside of the diaphragm is set at 15 psi., with a 30 psi. supply to the positioner, there is available a differential pressure of 15 psi. With an 80-square inch diaphragm, this amounts to 1200 lbs. loading.

Body Member

The most common type of valve body used for control purposes is the globe type comprising: (1) a stuffing box; (2) inner port; and (3) an inner valve.

Stuffing Box:

The stuffing box functions to seal the fluid flowing through the valve body, while permitting the valve stem to pass through as freely as possible. A nut is provided at the top of a sealing gland permitting access to the stuffing box chamber and providing a means of tightening the seal by compression on the packing material. Since this chamber can be the most serious cause of friction on the valve stem, the packing and lubricant for most fluids should provide an adequate seal with hand tightening of the gland nut. To further promote free action, the stem is highly polished. Good engineering practice today accepts packing depth to be six times the diameter of the stem member, with careful construction given to alignments and clearance of glands and other component stuffing box parts.

Temperatures of fluids above 450° F. cause excessive drying of the lubricant. For such applications, radiating fins are used to dissipate the heat before it reaches the stuffing box. Similarly, when fluid temperatures are below 32° F., an extension column should be used to separate the stuffing box from the valve body. This prevents stuffing box lubricants from becoming too viscous and also prevents frosting of the valve stem.

Single Vs. Double Port:

Valve bodies are available in single- or double-port construction. The inner port is described as the opening within the valve body into which the valve plug seats to throttle the flow.

In single-port valves, differential pressure acts over the entire bottom of the valve plug to create a vertical force on the valve stem. When the valve plug is in the closed position, moreover, the downstream pressure in many applications drops practically to zero. This increases the pressure differential across the valve so that the vertical thrust may con-

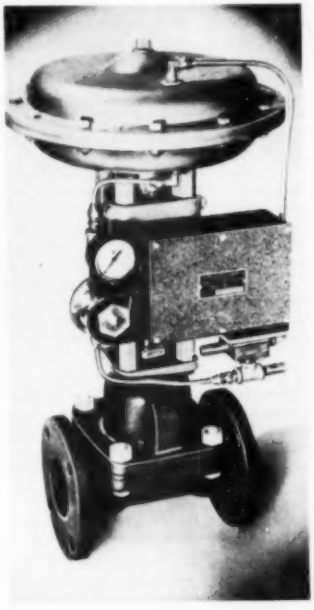


Fig. 2—Springless motor operator on a Saunders patent valve

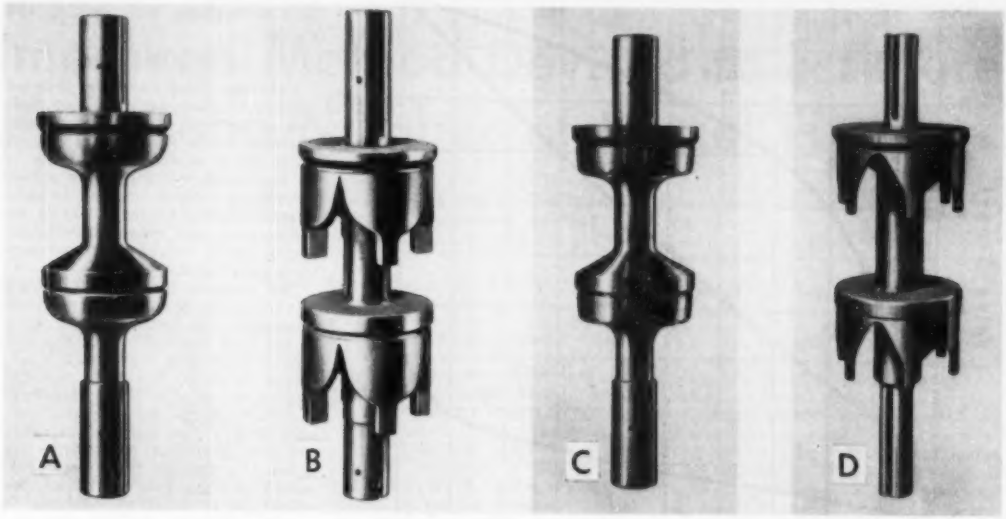


Fig. 3—A, linear plug, solid type; B, linear plug, V-port disc; C, equal percentage plug, solid type; D, equal percentage plug, V-port disc

stitute an appreciable force. The power unit must overcome this force in order to hold a direct acting (air-to-close) valve closed or to open a reverse acting (air-to-open) valve. For proportional control, the effect of the stem thrust is obviously undesirable.

The double-port body was designed to minimize the undesirable effects of this thrust. The inlet and outlet fluid pressures tend to balance themselves by acting both upward and downward on the two valve discs, resulting in what is termed a semi-balanced valve. For practical construction, however, the upper port is usually made slightly larger than the lower so that the lower valve disc may pass through the upper port when the inner valve is installed. The double-port construction has one disadvantage. With variation in temperature, the stem portion connecting the two valve plugs contracts or expands linearly a different amount than the valve body. In the closed position, therefore, one valve disc seats first and prevents the second disc from seating completely. This results in a minimum or "leakage" flow. Thus, when the tight shut off is required, a single port valve must be used.

Inner Valves

The most important factor in the over-all performance of the control valve is the flow characteristic which, in effect, describes the manner in which the control valve acts. The term "inherent valve characteristic" is used to denote the relation between stem position and flow under constant pressure drop. When the drop or pressure differential does not remain constant, as usually occurs in service, the characteristic curve is manifestly modified to provide what is termed the effective valve characteristic.

A complete discussion of valve characteristics is beyond the scope of this discussion which is limited to a description of the more common types of plugs used with control valves plus inherent characteristics.

There are three common types of inner valves: (1) quick opening; (2) linear; and (3) equal percentage.

Quick Opening:

This is a bevel-seated or poppet-type inner valve in which the area of the opening is determined by the perimeter of the disc times its valve lift. There are no restrictions after the inner valve leaves the seat, and the valve reaches maximum capacity at a relatively small proportion of lift. This type of valve is generally used for open and shut service.

There are numerous applications where process characteristics are such that adequate control cannot be obtained by a two-position valve of this type. Rather, the control element must possess a throttling characteristic or an ability to assume intermediate positions in its full travel, as dictated by the control instrument. This throttling valve must possess a higher lift than the on-off valve, since the higher the lift, the simpler it becomes to obtain a characteristic. These so-called high-lift valves are generally furnished with either of two types of inner valves: (1) linear, and (2) equal percentage.

Linear Plug:

This inner valve is supplied either as a V-port disc or as a solid plug (Fig. 3, A and B). The choice of either V-port or solid plug in clean service is largely a matter of user preference. The solid plug is a better selection when there is a possibility of plugging or erosion due to the presence of suspended solids in the fluid. The flow-lift plot for this plug is a straight line on rectilinear coordinates, giving equal volume changes for equal stem changes, regardless of per cent of valve opening (Fig. 4). This type of characteristic is needed where pressure drop in the system is largely concentrated in the control valve and most of the energy must be dissipated by it.

Equal Percentage Plug:

As with the linear inner valve, the equal percentage disc may be either V-ported or solid (Fig. 3, C and D). The flow lift curve at constant pressure drop is a straight line on semi-logarithmic paper. A control valve with this characteristic will produce a constant rate of change in flow per unit change in lift at constant pressure drop (Fig. 4). This change is always an equal percentage greater or smaller than the flow that existed at the moment preceding the increase or decrease in lift.

In general, the equal percentage inner valve can be used to advantage:

A—Where only a small percentage of the total system pressure drop is available across the valve.

B—When a control valve is in series

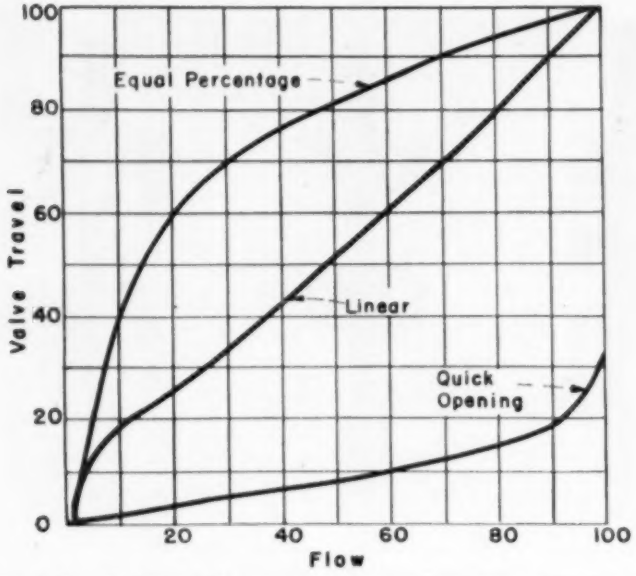


Fig. 4—Flow-lift characteristic curves for three common types of inner valve designs. The quick-opening type (bottom curve) is generally used for open and shut service: linear (middle curve) indicates equal volume changes for equal stem changes: equal percentage type has wide variety of uses

with pumps, heat exchangers and other resistances. Here pressure drop across the valve is likely to be low at high rate of flow but high at low flow. Even with variable flow and pressure drop, the equal percentage characteristic provides uniformly satisfactory control at any point of lift in excess of clearance leakage.

C—When operating conditions cannot be determined and it is necessary to install a line-size valve. It is rather difficult to oversize a valve with an equal percentage characteristic, which basically has the following capacities:

Valve Lift	Per Cent Total Flow at Constant Differential Pressure
25%	7- 8%
50%	12.5-15%
75%	37-40%
100%	100%

It is evident that the greatest percentage of flow is passed during the last portion of the lift. Note that at 50% opening the equal percentage inner valve gives about 13-15% capacity. The linear type on the other hand gives about 50% capacity of 50% lift.

Materials for Service

The design and construction features that are important for proper valve functioning have been discussed. The next factor to be considered is what type of body and trim materials must be used or can be used to handle the flow in question. For those unfamiliar with the term, trim applies to the lower stem, inner valve, seat rings and stuffing box parts.

Common body materials in use today and their specific application are as follows:

IRON: Up to 250 psi. and 250° F., where corrosion conditions permit the use of iron.

CAST STEEL: For use where pressures may be as high as 6,000 psi. and where temperatures do not exceed 600° F. Again corrosion conditions must permit the use of this material.

BRONZE: Pressures to 300 psi. and temperatures not exceeding 350° F., corrosion conditions permitting.

SPECIAL ALLOYS: Bodies may be made in special alloys such as acid resisting bronze, Hastelloys and 18-8 stainless steel.

The following are some of the more commonly used trim materials.

BRONZE: For low pressure drop across the valve. Generally not recommended over 35 psi. pressure drop.

STAINLESS STEEL: Suitable for elevated temperatures and for resisting erosion and wiring drawing. The most widely used stainless is type 316, and 18-8 steel with 1.75-2.5% molybdenum.

SPECIAL ALLOYS: Special alloys such as Hastelloys, Monel, red brass, nickel, etc., are available. Hardened stainless steel (450-500 brinnel) and Stellite facing on contoured plugs are used to minimize wire drawing and galling.

Effect of Valve Size

Even the most carefully designed diaphragm motor valve will not function at its best if improperly sized. Oversize valves wear out rapidly. A valve which is working too close to its seat tends to wire draw across the seating surface, resulting in early unserviceability. Valves should be selected from any manufacturer's capacity tables or charts; these exist in various forms.

For example, in the "C_v" method of valve sizing, the existing conditions (pressure drop, specific gravity, etc.) of the fluid flowing through the control valve are first converted in a reference condition. This is the quantity (gpm) of water at 60° F. that will flow through the valve with a pressure drop of one psi, and is called the flow coefficient (C_v). After the existing conditions have been converted into the flow coefficient, the valve size is found by referring to a table which shows valve sizes corresponding to the C_v.

There are three formulae for converting the given flow conditions into C_v.

FOR LIQUIDS:

$$C_v = \frac{Q\sqrt{G}}{\sqrt{h}}$$

where Q = quantity in gpm.
G = specific gravity (water = 1)
h = pressure drop in psi.

FOR GASES:

$$C_v = \frac{Q\sqrt{G(460+t)}}{1360\sqrt{hP}}$$

where Q = quantity in CFH. at standard conditions of 60° F. and 14.7 psia.
t = temperature in degrees F.
h = pressure drop in psi.
p = upstream pressure in psia.

FOR STEAM:

$$C_v = \frac{Q\sqrt{V}}{63.5\sqrt{h}}$$

where Q = quantity in lb/per/hr.
V = specific volume in cu/ft/lb. at the existing upstream pressure (psia.) and the existing steam temperature in degrees F.
h = pressure drop in psi.

In the formulae for gases and steam, when the existing pressure drop (h) is greater than 50% of the absolute upstream pressure, disregard the given pressure drop and use one-half the absolute upstream pressure for (h).

Improved Method Devised to Estimate Cetane Number of Diesel Fuels

Condensed from the paper "Methods for Estimating Cetane Number," presented at the 15th Mid-Year Meeting of the API Division of Refining, Cleveland, May 4

From a Report by H. D. YOUNG, Sinclair Refining Co.

AN improved method of estimating cetane number for a wide range of Diesel fuels between 15 and 85 has been developed by the CFR Diesel Fuels Division of the Coordinating Research Council. Known as the CFR Calculated Cetane Index, the method is a modification of the Calculated Cetane Number method devised by the Research Division of the Esso Laboratories. Like the Esso method, it is based on the API gravity and mid-boiling point of a fuel.

Within the commercial Diesel fuel range of 40-60 cetane number, the expected accuracy of this new index is reported to be close to ± 2 cetane numbers for 75% of the fuels to which it is applied. For the range of cetane numbers above 60, roughly 50% of the fuels will be estimated within ± 4 cetane numbers. The index is particularly applicable to straight-run Diesel fuels, catalytically cracked fuels, and blends of the two.

An alignment chart, reproduced on the following page, has been worked out to permit convenient determination of this index value from the API gravity and mid-boiling point.

A description of the method and the results of the studies leading to its development were presented at the API Refining Division meeting in Cleveland May 4 in a report on "Methods of Estimating Cetane Number," by H. D. Young, of the Harvey, Ill., research laboratories of Sinclair Refining Co. Mr. Young was leader of the Laboratory Methods Group of the CFR Diesel Fuels Division, which undertook the investigation to develop information on those indices currently used for estimating the ignition properties of distillate fuels, as expressed by ASTM cetane number.

"Calculated index formulae," Mr. Young's report explained, "represent a useful tool for estimating cetane number in the laboratory and in field service. Consequently, the principal objective of such a study was to determine which one of these currently used indices was superior from the standpoint of accuracy, correlation with ASTM cetane number, and convenience of application. A second objective was to find out whether a modified formula could be developed from the data which would be an improvement over those studied. . . .

"A considerable number of empirical equations have been proposed for evaluating the ignition quality of Diesel fuels ever since the need developed for such a determination. Most of the resulting indices are based on various physical properties of the fuel, namely gravity, volatility, viscosity, and aniline point, which reflect the fuel's chemical structure and thus, to a great extent, its ignition quality.

"Irrespective of the fact that the most acceptable measure of the ignition property of a fuel is its performance in an engine cylinder under the prevailing pressure, temperature, and speed conditions encountered, these various indices have found considerable usage both in the field and laboratory for estimating this characteristic. There are a number of reasons for this, such as lack of engine test facilities, adaptability to small sample rating, convenience, and rapidity of application."

Five indices known to be in general use at present were studied: Diesel index, calculated cetane number, characterized factor, ignition quality number, and modified ignition quality number.

Sixteen companies participated in the project,* and Mr. Young was assisted in his analysis and work-up of the data by Royce Childs, Waukesha Motor Co.; H. M. Gadebusch, General Motors Corp.; R. P. Gilmartin, Gulf Research and Development Co.; F. L. Nelson, Socony-Vacuum Laboratories; and W. K. Simpson, General Motors Corp.

Calculated index data and corresponding ASTM cetane numbers were submitted by the participants on 865 fuels, representing a wide variety of products from different crude sources and methods of manufacture. The greater majority of the fuels examined were distillate products which could be broadly classified as straight-run, thermally and catalytically cracked, and blends of straight run and cracked stocks. Data were included on a relatively minor number of residual stocks, coal tar products, synthetic fuels and pure hydrocarbons, but these, together with certain other data, were not included in the comparative analysis.

The five indices were evaluated principally on the basis of standard deviation of the data relative to ASTM cetane number. The analysis also included a study of the accuracy of correlation of the calculated date with cetane number. Based on the analysis, the established accuracy of the five indices, in descending order of merit, is as follows:

Calculated Cetane Number
Characterization Factor
Ignition Quality Number and Modified Ignition Quality Number
Diesel Index

It was concluded that Calculated Cetane Number was most satisfactory for the purpose, based on its accuracy, correlation, and convenience of use.

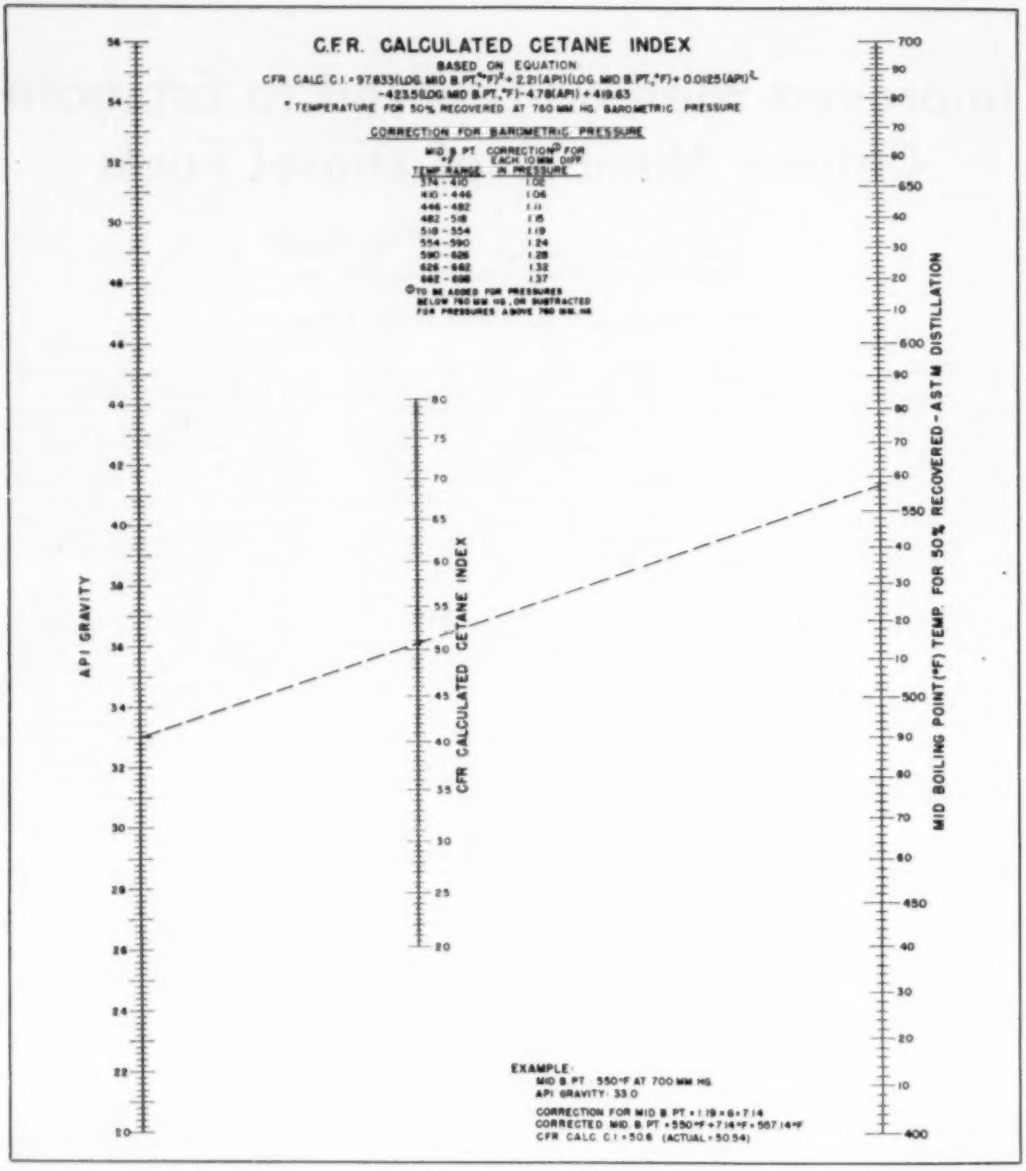
As a result of this study, a modification of the Calculated Cetane Number Formula has been proposed by the Laboratory Methods Group, and designated as the CFR Calculated Cetane Index. That formula is as follows:

$$\text{CFR Calculated Cetane Index} = 97.833\ (\log \text{Mid-Boiling Point, °F.})^2 + 2.21\ (\text{API Gravity})\ (\log \text{Mid-Boiling Point, °F.}) + 0.0125\ (\text{API Gravity})^2 - 423.5\ (\log \text{Mid-Boiling Point, °F.}) - 4.78\ (\text{API Gravity}) + 419.63$$

where Mid-Boiling Point represents 50% recovered by the ASTM distillation, corrected to 760 mm. Mercury barometric pressure.

This modification is based on the curvilinear regression equation (a statistical procedure) of the Calculated Cetane Number-ASTM cetane number relationship for the fuels studied. Application of this modified formula to the data investigated, the report states, shows the CFR Calcu-

* California Research Corp.; Ethyl Corp.; Fairbanks, Morse and Co.; General Motors Corp., Detroit Diesel Engine Division and Electro-Motive Division; Gulf Research and Development Co.; International Harvester Co.; Phillips Petroleum Co.; Pure Oil Co.; Shell Oil Co.; Sinclair Refining Co.; Socony-Vacuum Laboratories.; Standard Oil Co. (Ind.); The Texas Co.; U. S. Bureau of Mines; Universal Oil Products Co., and Waukesha Motor Co.


C.F.R. CALCULATED CETANE INDEX
BASED ON EQUATION
CFR CALC. C.I. = 97.833(LOG MID B.PT.,°F)² + 2.21(API)(LOG MID B.PT.,°F) + 0.0125(API)² − 423.56(LOG MID B.PT.,°F) − 4.78(API) + 419.63
* TEMPERATURE FOR 50% RECOVERED AT 760 MM HG. BAROMETRIC PRESSURE
CORRECTION FOR BAROMETRIC PRESSURE
MID. B. PT. °F* | CORRECTION① FOR EACH 10 MM. DIFF. IN PRESSURE
374 - 410 | 1.02
410 - 446 | 1.06
446 - 482 | 1.11
482 - 518 | 1.15
518 - 554 | 1.19
554 - 590 | 1.24
590 - 626 | 1.28
626 - 662 | 1.32
662 - 698 | 1.37
① TO BE ADDED FOR PRESSURES BELOW 760 MM. HG., OR SUBTRACTED FOR PRESSURES ABOVE 760 MM. HG.
API GRAVITY
CFR CALCULATED CETANE INDEX
MID BOILING POINT (°F) TEMP. FOR 50% RECOVERED - ASTM DISTILLATION
EXAMPLE:
MID B. PT. 550°F AT 700 MM HG.
API GRAVITY: 33.0
CORRECTION FOR MID B. PT. = 1.19 × 6 = 7.14
CORRECTED MID. B. PT. = 550°F + 7.14°F = 557.14°F
CFR CALC. C.I. = 50.6 (ACTUAL = 50.54)

lated Cetane Index is, in general, more accurate for estimating ASTM cetane number than the Calculated Cetane Number.

The modified equation is, of course, somewhat complicated for rapid application, but the alignment chart previously mentioned adapts it for practical use.

It is emphasized in the report that "any index for estimating cetane number represents an average relationship established for a variety of fuels. It must therefore be kept in mind that, in the use of such an index, certain discrepancies between the estimated cetane number and ASTM cetane number may be expected."

It is also brought out that definite limitations exist in the application of the CFR Calculated Cetane Index for estimating ASTM cetane number. These are:

1—It is not applicable to fuels containing additives for increasing cetane number.

2—It is not applicable to pure hydrocarbons, synthetic fuels, fuels produced by alkylates, and coal tar products.

3—Considerable inaccuracies may occur if it is applied to crude oil, residual fuels, or fuels of below 400° F. end point.

Finally, Mr. Young points out that the CFR Calculated Cetane Index is merely "a tool for estimating ASTM cetane number" and that "it cannot be substituted for the ASTM cetane number as determined in a test engine."

Scrubbing Devices Successfully Control Air Pollution from Refinery Processes

This paper was presented under the title "Scrubbing Devices for Air Pollution Control" during the 15th Annual Mid-Year Meeting of the API Division of Refining in Cleveland, May 3

By EINAR P. KROPP, Supervisor, Technical Service Division, Standard Oil Co. (Ohio), Cleveland

The recently increased emphasis on air-pollution control necessitated an investigation at one refinery to determine if the undesirable odors and gases from certain batch processes could be successfully removed by scrubbing procedures. The worst nuisances were associated with asphalt manufacture, acid treating of lube oils, and grease making.

Pilot-plant experimentation revealed the utility of the "fog-filter" type of unit for odor control in grease processing and lube-oil acid treating. Asphalt fumes are given water spray treatment and then burned. High degree of fume removal was reported through use of the fog filter.

SINCE 1946 considerable interest has been shown by Cleveland civic, municipal, and industrial groups in the field of air-pollution control. It is generally understood by those who have worked in the field of air pollution that toxic limits are fairly well established for certain pollutants. The nuisance factor to other industries, home owners, and residents of the area can only be determined by obtaining their reactions to the various waste products discharged.

An understanding of the problems by these people is most helpful. The technical work which will be presented in this paper was discussed and reviewed with civic, municipal, and industrial groups. The mutual interest of all groups concerned led to a rapid economical solution of potentially serious air-pollution problems.

In cooperation with the municipal program, potential sources of air pollution from refinery operations were investigated. These investigations showed that, in the Sohio operations, there were three major sources of possible air pollution, as follows:

1. *Acid treating of lubricating-oil stocks*: The conventional sulfuric-acid treatment of lubricating-oil stocks and acid-sludge treatment result in large quantities of sulfur dioxide and some sulfur trioxide being evolved. These gases are especially obnoxious when present in appreciable concentrations in the air. The survey showed that atmospheric conditions could aggravate the effect of even small quantities of pollutant.

2. *Grease manufacture*: A number of the grease-making processes utilize fatty acids. These fatty acids may have unpleasant odors, especially when heated during processing. In addition, certain grease processes evolve hydrogen sulfide. Hydrogen sulfide is the well-known source of the "rotten-egg" odor in refineries and, in addition to being highly disagreeable, it is both toxic and flammable.

3. *Asphalt manufacture*: During the peak summer operations the fume-disposal system was heavily loaded. The disagreeable portion of the fumes consist of hydro-carbon aerosols and vapor. The inert portion consists mainly of nitrogen and blanketing steam.

Studies were made of these three process sources to determine a means of minimizing the odor nuisance. A characteristic of the nuisance sources was the periodic release of the pollutants in quantities sufficient to be obnoxious; but, in general, the total quantity of pollutants released was not excessive. The reason for this behavior was the batch nature of the processes concerned. The amount of pollutants was not great enough to warrant consideration of economical recovery processes; but, on the other hand, the concentration of the pollutant was sufficiently high to be a potential short-time nuisance. The problem thus became one of converting the offending material into a form for satisfactory disposal.

Fumes from Acid Treating

There were two sources of fumes from the agitator area where lubricating oils were treated with sulfuric acid. These were the agitators during the air-blowing operation and the sludge separators when acid sludge was being digested with caustic.

A preliminary pilot-plant investigation of a conventional spray tower was made. The purpose of this investigation was to determine whether this simple form of apparatus might be applicable. The tower consisted of a vertical 20-in.-diameter pipe having an effective spray section 18 ft. long. The spray was furnished by a single spray nozzle located at the top of the tower. The fumes were passed countercurrent to the spray, and were discharged from the top of the tower. The results of scrubbing the fumes from the sludge separators using the spray tower are shown in Table 1.

Within the foregoing range of conditions, the removal of sulfur dioxide from the fumes was negligible. It was obvious that this equipment did not solve the problem of removing sulfur dioxide from the fumes.

As a result of the agreement of other investigators that low-pressure spray towers are ineffective in this service, a survey of potentially more efficient scrubbing devices was made, and this led to the testing of the commercial scrubbing device called a fog filter. This equipment was inspected in several non-petroleum applications, and it was felt that it was giving satisfactory performance in acid-fume and dust-removal service.

Experimental Fog-Filter Unit

The general characteristics of the unit are indicated in Fig. 1. Essentially the equipment consists of two cylindrical spray chambers connected by a cross-over duct. The fumes are conducted close to the bottom of the

TABLE 1 — Operating Conditions of Sludge-Separator Spray Tower

Fume rate, cfm	1,000
Fume inlet temperature, deg. F	212
Fume outlet temperature, deg. F	120
Water rate to scrubber, gpm. (at 40 psig.)	20
Water inlet temperature, deg. F	90
Water outlet temperature, deg. F	150
Sulfur dioxide concentration, inlet, ppm.	1,500
Sulfur dioxide concentration, outlet, ppm.	1,400

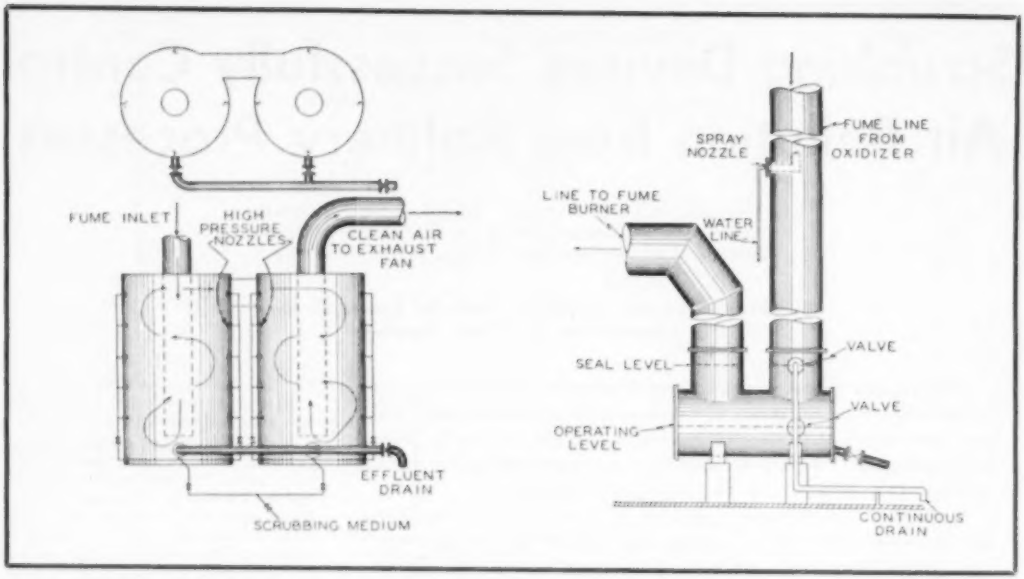


Fig. 1—Left: Diagrammatic sketch of the fog filter

Fig. 2—Right: Fume scrubbers for asphalt oxidizers

first chamber by a central inlet tube; then they pass up the cylinder in a centrifugal motion, through the crossover duct to the second cylindrical chamber. The gases pass down the second chamber in a centrifugal motion and, finally, up and out through a central tube in the second chamber. The gases are drawn through the equipment by means of an exhausting blower located on the outlet of the unit. The scrubbing medium was introduced through a number of fog nozzles. These fog nozzles were placed at an angle around the periphery of the cylindrical chamber so as to induce a rapid centrifugal motion of the gases. This centrifugal action served to disengage the fog droplets from the gases, and prevented entrainment of odoriferous mist.

It has been reported in the literature that a high degree of atomization of the scrubbing medium was necessary in cases of difficult gas absorption, odor removal, or dust removal. The performance of the units in existing industrial service confirmed these findings. To insure a high degree of atomization, the apparatus was equipped with a pump which maintained a pressure of 350 psi. to 400 psig. at the nozzles. The physical dimensions and liquid capacity of the unit are listed in Table 2.

Sulfur-Dioxide Absorption

The absorption of the sulfur-dioxide portion of the fumes from the acid treating of lubricating oil presented the most difficult problem. Trial runs were made in which the conditions simulated those found in the plant.

A 3% solution of soda ash in water was used as the scrubbing medium. At a concentration of 10,000 ppm. of sulfur dioxide, at an air rate of 100 cfm., and at a spray rate of 20 gpm., the sulfur-dioxide concentration was reduced to less than 1 ppm. Typical results are summarized in Table 3.

From these experimental data it was concluded that the fog-filter type of scrubbing unit gave a satisfactory removal of the sulfur dioxide.

Grease Manufacture

Due to the success of the fog filter on sulfur-dioxide absorption, an experimental program was carried on to determine the feasibility of using this equipment for hydrogen-sulfide absorption. Presented in Table 4 is a summary of several of the experimental runs.

The first trial was made with water as a scrubbing medium. It was found that water was relatively ineffective. A second trial with a 3% soda-ash solution reduced the hydrogen-sulfide concentration in an air stream of 1,000 cfm. from 2,200 ppm. to 200 ppm. To achieve a higher absorption efficiency, an 8% caustic-soda solution was used. This solution completely removed hydrogen sulfide from air even with an inlet concentration of 45,200 ppm.

It is inherent in grease manufacture that fatty-acid odors are present. Under certain atmospheric conditions

TABLE 2—Physical Dimensions and Rated Capacity of Pilot Fog-Filter Unit

Number of Chambers	2
Diameter of chambers, ft.	5
Height of chambers, ft.	8
Number of nozzles per chamber (4 vertical headers, 5 nozzles per header)	20
Diameter of concentric duct, ft.	1
Rated fume capacity of unit, cfm.	850
Rate of scrubbing liquid, gpm. at 40 psig.	20

TABLE 3—Experimental Results on Fog Filter

Pollutant	SO_2
Concentration, inlet, ppm.	10,000
Concentration, outlet, ppm.	0
Temperature, inlet, deg. F.	50
Temperature, outlet, deg. F.	40
Scrubbing liquid	Soda Ash
Concentration, scrubbing liquid, wt.-%	3

TABLE 4—Experimental Results on Fog Filter

General Data:

Pollutant	Hydrogen Sulfide
Fume rate	800 to 1,000 cfm.
Rate of Scrubbing liquid	20 gpm. at 400 psig.
Approximate temperature of scrubbing liquid	70° F.

Conc. Inlet, ppm.	Conc. Outlet, ppm.	Temp. Inlet, ° F.	Temp. Outlet, ° F.	Scrubbing Liquid	Conc. Scrub. Liq., Wt.-%
4,200	3,900	250	115	Recycle water	
2,200	200	200	100	Soda ash	3
2,100	50	50	40	Soda ash	8
45,200	0 to 500(1)	50	40	Caustic soda	8.5
2,000	0	50	40	Caustic soda	8.5

(1) Concentration at outlet increased as caustic rapidly became spent.

the offensive quality of these odors is accentuated. By the use of the fog filter it was found that these odors can be completely absorbed, using water as a scrubbing medium.

Full-Scale Plant Application

As a result of these investigations and the performance of large units in other service, two full-scale units are being installed for the control of hydrogen sulfide, sulfur dioxide, and fatty-acid odors.

Asphalt-Oxidizer Fumes

The fume-disposal equipment for the asphalt-oxidizing plant was installed several years ago. Increased production since that time has resulted in high loading of the fume-disposal equipment during peak periods. The fume-disposal system consisted of collecting pipes which carried the fumes directly to fume burners. In order to decrease the load on the fume burners as well as the dust-collecting system, a device was designed and installed to condense the blanketing steam present in the fumes. The equipment used is illustrated in Fig. 2.

TABLE 5—Typical Operating Conditions of Scrubbers for Asphalt Oxidizers

Fume rate, cfm.	3,200
Fume inlet temperature, deg. F. (max.)	490
Fume outlet temperature, deg. F.	225
Water rate to scrubber, gpm.	10
Water inlet temperature, deg. F.	40 to 105
Water outlet temperature, deg. F.	140 to 175

The fumes from an oxidizer are conducted down a vertical pipe, past a spray nozzle, and into a horizontal cylindrical drop-out section. In this section the spray and condensate are disengaged from the fumes and sent to the waste-water system. The scrubbed fumes then go to the fume burner. With the equipment described, the fume load has been reduced by 33%. The operating conditions are listed in Table 5.

Insufficient data are at hand to evaluate definitely the improvement in the performance of the fume burners. There is evidence that more efficient combustion is taking place. An interesting advantage has resulted from this equipment. Formerly dampers and sliding blinds were used to isolate oxidizers not in use from direct connection with the fume burner. These valving devices were subject to difficulties from asphalt accumulations on the dampers, or from leaks around the blinds which added to the fume problem. By raising the water level in the drop-out section, the scrubber could be used as a water seal, and thus effectively and simply isolate an oxidizer not in service. Further study of this problem is contemplated to determine the optimum procedure for minimizing the air pollution from this source.

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Design of Cathodic Protection For Open-Box Type Coolers

Slight Condensation of Paper of same Title Presented Before the Corrosion Session, API Refining Division, Cleveland May 2

By C. R. DRAUGHON, Jr. and E. B. McNEIL
Equipment Inspection Dept., Esso Standard Oil Co., Baton Rouge, La.

Corrosion on the water side of open-box type coolers is being effectively controlled by cathodic protection, at the Baton Rouge refinery of Esso Standard Oil Co. Sufficient data were obtained from the installation of an experimental cathodic-protection unit on a large cooler to provide for more definitive and economical installations on two additional coolers. To assure protection throughout any system, a sufficient current density must be maintained, and a large anode system with relatively close spacing between anodes, in order to distribute current equally. A cathodic-protection installation can be made for about one-third the cost of replacement of a cooler. Average cost for protection is about 66 cents/sq. ft. of surface protected.

AT the Baton Rouge refinery of Esso Standard Oil Co. an attempt is being made to reduce or prevent the water-side corrosion of open-box coil coolers by means of cathodic protection, and thus reduce the high maintenance costs on this type of cooling equipment. Also it is anticipated that replacements can be deferred for a considerable period and that the extensive use of high-cost alloy steel can be avoided.

Through February, 1950, three worm-type coolers of a conventional type have been protected. The first was of an experimental nature, the cost being high for the protection obtained.

Recirculated cooling-tower water and raw Mississippi River water are the two types of coolants used at Baton Rouge, and their analyses are shown in Table 1. The corrosion on the water side of the tubes has been in the form of tubercules, which resulted in deep pitting and short life. It is estimated that the average service life of a steel cooler coil in river-water service is about three years, but this varies to some extent with the operating temperature.

The pipe coils of the cooler in which the experimental cathodic protection unit was installed had had a service life of approximately 30 months, and the annual maintenance cost was estimated at $6,000—with complete replacement costing about $15,000.

The cooler selected for the initial cathodic-protection installation contains two carbon-steel coils—the coolant being well water, which is recirculated through a cooling tower. As shown in Table 2, this compartment contains a cooling-surface area of

5,440 sq. ft. and a box area of 2,156 sq. ft., or a total area of 7,596 sq. ft. requiring protection. When the installation was designed, there was little information available on the design of systems to protect open-box coolers. The meager data indicated that protection had been achieved with current densities anywhere from 1 to 8 milliamperes per sq. ft., and no water analyses were correlated with these data.

It was apparent from the start there were two main problems, viz.: current density requirements, and current distribution. The data available formed the basis for an estimate that an average of about 3 milli-amperes per sq ft. would be needed to give protection in water of our analysis, and that a potential change of 150 to 200 millivolts was to be expected, but not much more. Because of the experimental nature of the installation, it was decided to design on the basis of obtaining more protection than these estimates indicated would be needed. A total current capacity of 50 amperes was estimated to be necessary to protect the coils and the box, supplying an average of 6.6 milliamperes per sq. ft. to the surface to be protected.

Rectifier

The rectifier installed is a standard copper-oxide oil-immersed unit rated at 15 volts and 100 amperes maximum direct-current (DC) output. The 100-ampere rectifier was selected so that sufficient capacity would be available to protect a similar cooler coil and box adjacent to the one described herein. Primary connection was for 440 volts, 3-phase alternating current (AC). Control of the DC output was obtained by positive-contact link adjustment in 12 steps. A magnetic circuit breaker was used for electrical protection.

TABLE 1—Baton Rouge Cooling Water Characteristics

Property	Well Water Recirculated in Cool. Tower	Raw Miss. River Water
Total alkalinity, ppm	254	90
Total hardness ($CaCO_3$), ppm	24–30	90–115
Total solids, ppm	160–350	200–250
Silica (SiO_2), ppm	32	6
Chlorides (NaCl), ppm	48	40
Sulfates (SO_4), ppm	6	52
Turbidity	...	320
pH	8.0	8.0
Operating temp., °F.	170–190	120–180
Specific resistance, ohm-cm.	580–1230	1040–1700

TABLE 2—Physical Data on Cooler Boxes for Units I and II

	Unit I	Unit II
Tubes:		
Size, in. O. D.	4½	4½
Number	144	121
Number across	16	11
Number down	9	11
Length, ft.	30	32
Return Bends:		
Size, in. (nominal)	4½	4½
Number	144	110
Box:		
Dimensions, ft.	38x22x11	36x12x9
Area, sq. ft.	2,156	1,296
Area:		
tubes ret. bends, sq. ft.	5,440	4,280
Total area:		
tubes & box, sq. ft.	7,596	5,576

Inasmuch as it appeared that more effective protection could be obtained with a large anode surface and close anode spacing, a total of 104 flat steel-plate anodes was installed as shown in Fig. 1. Each anode was made of ⅜-in. plate, 12 in. wide, and 10½ ft. long, extending to within 6 in. of the bottom. A center-to-center spacing of 30 in. was maintained except where limited by physical conditions in the box, and a row of anodes was installed parallel to and between every other vertical bank of tubes. Anode-current density was set at 30 milliamperes per sq. ft., and it was estimated that a life of about 4 years would result. Anodes were suspended from supports in the top of the box, which were constructed of wood and structural steel (Fig. 2). The wood also served as electrical insulation between the positive side of the rectifier and the box, which was negative. Wooden positioners in the bottom of the box held the anodes from swaying.

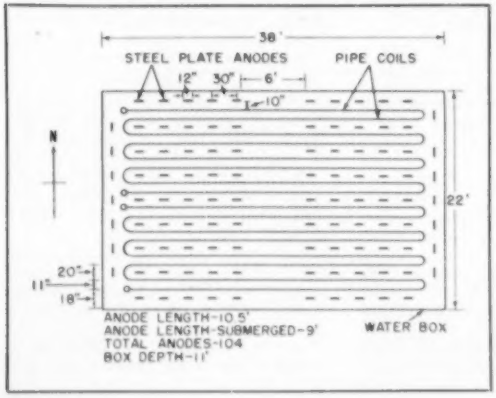
Electrical System

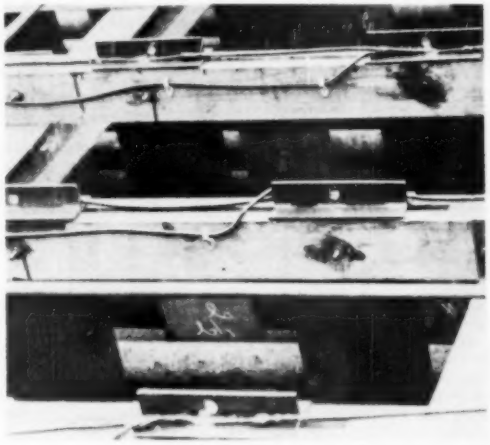
The details of the electrical system are given in Fig. 3. All DC leads were designed to permit only a negligible voltage drop, so that the rectifier voltage required could be held to a minimum. Current from the rectifier was supplied to bus bars, and from these to the anodes. Current was drained from each vertical bank of tubes to a main drain lead, which also drained the box wall. The system was designed to provide electrical symmetry in both the anode and drain leads. Also a number of open-end leads were installed to permit a variety of experimental studies. All copper-to-steel connections were made by brazing.

Results of Protection

The unit has now been in continuous service for 21 months since protection was initially applied. During this operational period numerous surveys were made on the cooler box, and considerable data accumulated. The surveys made consisted of pipe-to-water potential and current-density measurements. All pipe-to-water potential measurements were made by the utilization of a calomel exploring electrode. Current-density surveys were made, and these used a probe consisting of a flat steel plate of small area which was connected into the protection circuit, together with a milliameter. The following is

Fig. 1—Below: Anode arrangement for Unit I
Fig. 2—Right: Anode supports used on Unit I





a summary of the data obtained on the protection unit during the 21-month period mentioned.

Potentials Along a Pipe

1—As indicated in Fig. 4, readings taken along the length of any particular pipe show that the potentials are lower at points opposite the center of the space between anodes than at points on the pipe or wall surface directly opposite the center of an anode. Although the curve shown has been plotted from spot readings, it was found from the data that potentials on the pipe averaged about 15% lower between anodes than opposite anodes. Also, the distribution pattern was similar along the length of the pipe at any particular location.

2—Points of minimum protection are the box walls and corners, and the wall and coils in the center of the box where there are no anodes. This condition results from the lack of sufficient anodes to achieve satisfactory current distribution. In general, all areas of the coils where anodes were located were found to have high potentials. One exception to this was an area in the southeast portion of the compartment where an area of low potential was found. It was believed that this was due to an increased depolarizing action caused by vigorous agitation of the water which was noted in this location.

Potentials Across the Tubes

3—As seen in Fig. 5, a trend in the readings taken in a north-south direction indicates a decrease in the pipe-to-water potentials toward the south end of the compartment. This might be explained by the fact that the water in this area is at a somewhat higher temperature and circulates more rapidly—thus causing increased depolarizing action.

4—The potentials on the top of the coils were found, on the average, to be approximately 30% higher than the potentials on the side of the pipe facing the anode, and 40% higher than the potentials on the side of the pipe away from the anode. Although the curve in Fig. 5 indicates only spot readings, this trend can be seen easily. Higher potentials on the top of the pipe can be attributed to a layer of scale which formed a protective coating at this point. Although it is present on the pipe tops without applied current, this precipitation of insoluble calcium carbonate and magnesium hydroxide is greatly increased when protection is applied.

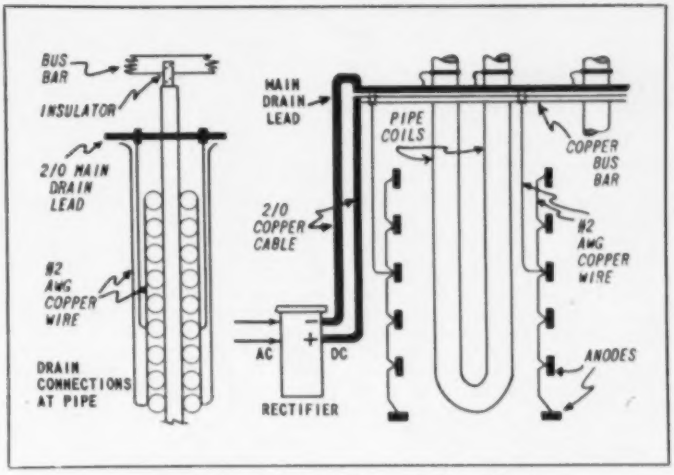


Fig. 3—Electrical details for protection, Unit I

5—With a total rectifier output of 40 amperes, protection was achieved on approximately 65% of the coil-and-box surface area. This current supplies an average current density of 5.3 milliamperes /sq. ft.

6—A greater improvement with time was shown in areas of minimum protection as compared with areas of maximum protection. This was true even though the total current applied decreased slightly. This could be attributed to a buildup in protection of the cathodic areas initially which, as time progressed, was extended to less protected or anodic areas. The extent of this increase in protection was not sufficient to achieve the desired results even after the total current through the system had been increased.

7—Pipe-to-water potential could be increased by increasing the rectifier output, although not in proportion.

8—It was also found that potential readings on the bottom of the box were somewhat higher than those of the coils. This higher potential is caused by a protective scale on the box bottom. Measurements made at different levels in the box indicated that, although the potential varies as much as 15% from the top coil to the bottom coil, no consistent

Fig. 4—Left: Surface potentials along a pipe, Unit I

Fig. 5—Right: Surface potential measurements, Unit I

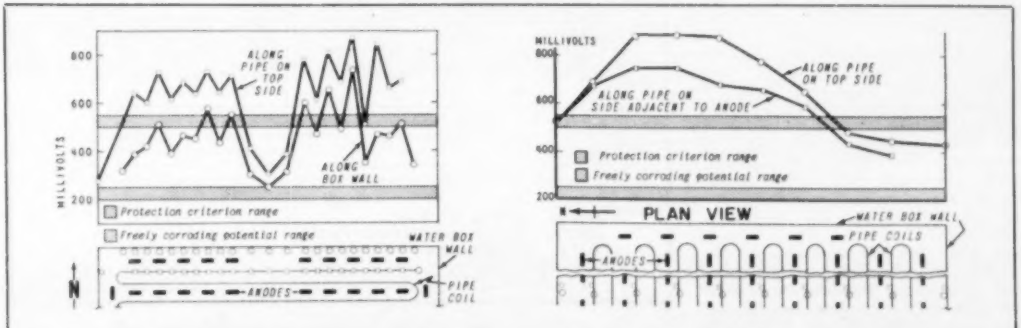


TABLE 3—Comparison of Cathodic Protection Costs

	Unit I Exper.	Unit II	Unit III	Total for Units II, III
Area protected, sq. ft.	7,596	5,576	2,050	7,626
Replacement value, coil, $	15,000	11,500	4,200	15,700
Installation cost, $	7,000	3,100	1,950	5,050
Operating cost, $/yr.(1)	96	36	10	46
Unit cost, ¢/sq. ft.	92.2	----	----	66.3

(1) Does not include replacement cost of anodes.

variation in potential with depth had been noted.

9—To make a determination of the actual rate of corrosion with and without protection, carbon-steel samples were installed in the box. A total of six protected and six unprotected samples was placed in various locations. The average pit penetration based on the estimated area attacked was observed to be from 0.02 in. to 0.05 in. per year on all of the samples, as compared to 0.15 in. per year on the coils as determined prior to the installation of protection.

Additions to Protection Unit

As a result of our surveys made during the initial period of protection, it was thought advisable that steps should be taken to achieve protection in the areas of low potential. It was decided to install additional anodes in the center portion of the coils and in the four corners of the box, and to increase the rectifier output to approximately 80 amperes—thus giving an average current density of 10 milliamperes per sq. ft.

The additional protection consisted of installing 31 anodes in the center of the coils and in the corners of the box. The anodes were graphite pipe, of 1 in. outside diameter and ¾ in. inside diameter. One anode was installed in each corner of the box, and three anodes were installed in each of the nine existing anode rows in the center of the coils. The additional anodes were connected in parallel to the existing electrical system. No additional drain leads were installed.

Protection of Other Coolers

Because of the favorable results obtained in the first installation, protection units were installed on two additional open-box coolers. Protection of these coolers resulted in a saving of more than $10,000 by the elimination of the necessity of replacing the two coils. Unit II, costing $3,100, was placed in service in September 1949. In December of the same year, unit III, costing about $2,000, was completed and went into service. Both coolers are cooled with untreated Mississippi River water, and have an estimated service life of from 4 to 5 years without cathodic protection. Because the design for both units is similar, only the installation details of unit II will be given. Physical data on the cooler are shown in Table 2.

The rectifier is rated at 75 amperes and 12 volts DC output, and is a standard selenium oil-immersed unit, complete with a thermal overload relay, volt and ammeter, and power switch. This rectifier has a capacity slightly larger than design requirements of 60 amperes, as this was the nearest size available without encountering undue delays in delivery. However, it provides excess capacity, which can be utilized if deemed desirable.

From our previous experience it was felt desirable to utilize cylindrical anodes placed closer together, instead of the flat plate, for the purpose of affording better distribution of current. Carbon steel was chosen as an anode material in order to reduce initial costs. Concrete reinforcing rods, 1 in. diameter and 9 ft. 2⅜ in. length, were utilized throughout—thus permitting rapid installation. Fig. 6 shows the anode arrangement. The spacing between anodes is 16 in., and the arrangement was designed so as to provide for an anode row between the outer row of tubes and sides of the box—thus assuring satisfactory protection for the box itself. There is a total of 189 anodes, each having an estimated life of 3 years. Anode supports consisted of wood sleepers which held the lower end of each anode in place, and which also insulated the anodes electrically from the box bottom. The upper end of each anode was held by welding into a 2-in. by 2-in. angle running along the top of each anode row. Size 3-in. by 3-in. angles supported the anodes on the top of the box, and 3-in. by 4-in. timbers served to insulate the supports from the anodes.

DC-Current Leads

All positive and negative leads were designed to permit only a negligible voltage drop, thus reducing the required rectifier-output voltage. This was particularly important in the negative leads in order to drain all current supplied to the system while at the same time preventing a portion from leaking off to adjoining structures. Insulated No. 00 AWG stranded-copper cable was used for all main leads. Secondary leads utilized No. 4 AWG copper wire. The upper anode-support structure, constructed of 2 in. by 2 in. angles, was also used for part of the positive circuit in order to reduce construction costs and to eliminate the use of more expensive copper cable. In addition, more even distribution of current to the anodes resulted. The current-drainage system was simplified over that used in the previous installation. Each end of every two tubes was drained by bonding a negative lead to each return bend in the worm. The box was drained at six points—this bonding being done on the outside of the box, for convenience. Wherever possible, all electrical connections utilized thermite bonding.

Results of Protection

As a result of two years of experimentation, it was concluded that cathodic protection is an effective means of controlling corrosion of open-box type coolers. Economically, this technique can be justified because it eliminates the need of replacement of corroded equipment, or because it reduces maintenance costs, or both, as indicated in Table 3.

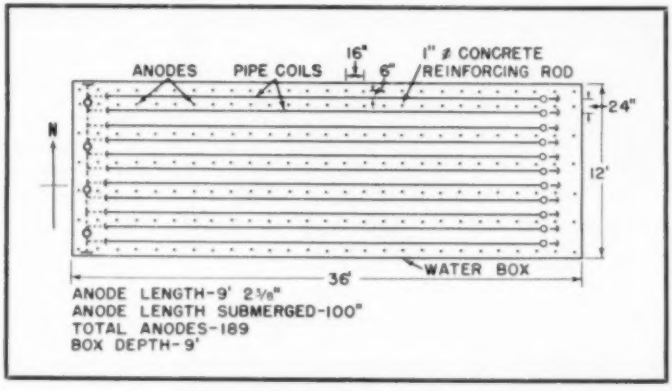


Fig. 6—Anode arrangement for Unit II

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Air-cooled Heat Exchangers . . . Economics of Use in Refineries

By KENNETH D. DEMAREST
The Fluor Corp.

FOR many years air-cooled heat transfer equipment has been proving its worth by giving reliable economic service in all parts of the world. While at first these applications were numbered and operators were skeptical, time has corrected miscomprehensions and mechanical difficulties until at present satisfactory performances are being obtained, and new applications are being revealed continuously. By making mention of a few of these applications, it may be possible for plant operators, engineers and others to see further applications in their own plants. It may also provide argumentive material for those who are struggling against outmoded ideas.

Many times the addition of an air-cooled exchanger to an already existing plant proves the most economical means of obtaining additional cooling capacity, since often at the time of plant design, equipment is not overdesigned for future growth.

One particular instance of this nature is a large oil refinery where it was found necessary to pick up an additional cooling load of 180,000,000 Btu/hr. in connection with a catalytic cracking unit. This extra cooling load could only have been obtained by providing an additional water supply, and due to limitations imposed by the size of water lines already existing, the air-cooled unit was an ideal solution, as it could be substituted as additional heat exchange equipment, and due to the self contained nature of the air-cooled unit, no modifications in the plant were necessary beyond electrical connections for the fan driving motors.

Table 1 shows a number of different types of installations where air-cooled exchanger equipment is being satisfactorily used. It indicates not only the large variety of applications, but also the relative size and cost. Services such as engine-jacket water-cooling and exhaust condensing have purposely been omitted, since in this field, the application of the air-cooled transfer equipment has been so extensive that information concerning them is already available.

Cost Variation

No correlation is noticeable between cost and heat transfer rate, since this is also a function of the temperature conditions. Where temperatures for a particular type of service are generally standardized, costs will be somewhat indicative, but atmospheric temperatures also affect the size and cost of a particular installation. The information presented in Table 1 is intended only as a guide for those interested in this type of equipment.

Still another item to be noted is that the particular type of fan drive employed for the different installations is not stated. All three common types of drives are used in connection with air-cooled exchangers. Of the three—gas engines, electric motors, and steam turbines—the electric motor is by far the most commonly employed, because individual fan drives seldom exceed 50 or 60 hp.

Passing on from the matter of fan drives leads to the consideration of fan horsepower itself, in relation to the work being performed. The listing also indicates variation in fan horsepower required per Btu/hr. dissipated for similar services. This is also to be expected because the evaluated first cost of a unit must be balanced off against annual operating charges, consistent with the policy of each user with respect to payout period. In general, it is economical to install a higher initial cost unit if substantially lower horsepower consumption is realized.

One item that causes the air-cooled heat exchanger to lead in its applications is its wide variety of control with respect to heat dissipation and temperatures. Generally speaking, three methods are used for control in this type of equipment. These are to control the rate of flow of either air or fluid through the equipment, or the amount of heat transfer surface employed. If the process operation requires constant rate of flow of the fluid being cooled, variation in performance may be obtained through the use of a bypass regulator taking its authority from a controller appropriately located. Further control may be effected by valving off portions of the unit, normally by hand.

Control on the air side may be obtained by regulating the rate of air flow through control of fan speed, number of fans in operation, and dampers. This is usually necessary to some degree, due to seasonal changes in ambient air temperature, and depends to a great extent on the locality of the installation. Electric motors with two-speed control

TABLE 1—Costs and Other Details for Actual Installations of Air-cooled Heat Transfer Equipment

Service	Heat Transfer 1000 Btu./hr.	Total fan hp.	Ground Space, ft.	Installed Cost, $
I. Vapor Condensing:				
Gasoline condenser	8,500	50	16 x 21	18,150
Reflux condenser	18,407	90	48 x 25	55,000
Hydrocarbon overhead condenser	12,870	40	23 x 21	19,420
Still reflux condenser	18,715	80	46 x 21	35,800
Primary condenser	4,652	40	11 x 25	13,400
Hydrocarbon condenser	10,360	40	23 x 17	19,500
Still overhead condenser	4,875	34	16 x 21	17,590
Debutanizer condenser	11,930	60	23 x 25	26,980
Still condenser	7,180	30	16 x 25	18,550
Still reflux condenser	39,110	60	46 x 25	44,735
II. Gas Cooling:				
Natural gas after-cooler	10,680	40	23 x 25	24,610
Natural gas after-cooler	13,920	80	46 x 25	47,200
Natural gas inter-cooler	4,230	40	16 x 21	15,300
Manufactured gas cooler	11,165	50	23 x 21	19,400
Natural gas inter-cooler	7,790	60	25 x 25	24,350
Natural gas after-cooler	3,400	15	11 x 21	8,600
Natural gas inter-cooler	7,890	40	23 x 21	21,000
Natural gas after-cooler	9,700	40	23 x 21	22,000
III. Liquid Cooling:				
Stabilized crude cooler	125,100	700	315 x 25	300,000
Amine solution cooler	19,300	175	38 x 25	39,370
Soap solution cooler	5,070	80	23 x 25	33,000
Quenching oil cooler	1,665	50	23 x 25	23,945
Absorption oil cooler	14,000	120	32 x 25	38,600
Absorption oil cooler	14,915	100	32 x 17	38,750
Cocoanut oil cooler	675	15	6 x 17	6,150
Vegetable oil cooler	628	15	6 x 17	6,150
Cotton oil cooler	558	5	6 x 21	6,870

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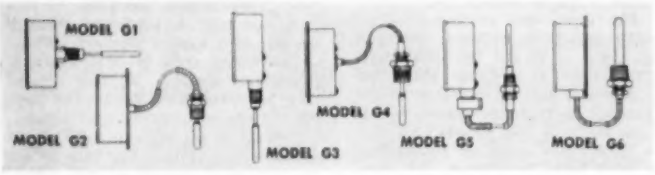

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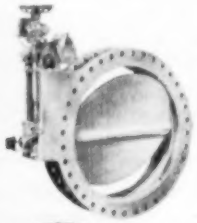

Butterfly valve, 42" pipe size, 125 lbs. flanged drilling, complete with motor and remote control having a torque of 300 ft. lbs. Streamlined blade moves on needle bearings; may be operated by auxiliary hand wheel.

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Wafer type butterfly valve for close pipe coupling, 36" pipe size, with air diaphragm operator and pilot valve.

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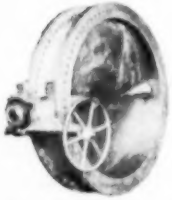

Butterfly valve 66" pipe size, hand wheel operated for a 7½ lb. air line in the power and blower division of an activated sludge plant. Yes, this is big, but we build them even as small as 1" size —cast or fabricated—for handling anything from fly ash to corrosive vapors containing abrasive particles, river water or high temperature gases or liquids, paper pulp, etc.

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afford the simplest means of heat transfer regulation, especially on a large multiple unit. Mechanical dampers and valve controlling of the number of units in operation is usually a manual function, while the electric motor control may be performed from the main control center.

The use of dual speed electric motors or speed controllable gas engines and turbines tends toward greater economy and trouble free operation than by the use of damper regulators. This fuel saving may amount to a considerable sum when it is realized that at half speed the power requirement will be approximately one-quarter.

Installation and Operating Practice

Air cooled heat exchangers have been both ground and roof mounted, and installed indoors, as well. They are much easier to mount than cooling towers, since a basin is unnecessary and footing loads are less. No special precautions must be observed as regards wind direction, as practically all units now available use horizontally disposed fans drawing air in bottomside from whichever side it may come, and discharging it vertically at substantial velocity. No case of air recirculation seriously impairing the efficiency of a unit so constructed has yet been reported, although this has been considered a possibility.

Precautions necessary to avoid freeze-ups are limited to the fluid being cooled. These consist of preventing too low a rate of circulation through the unit, reducing air flow as previously noted, and providing good drainage when shutdowns occur. Some users have found it advantageous to use an anti-freeze in connection with closed recirculated water systems.

In conclusion, it may be safely predicted that the place of air-cooled heat transfer apparatus in the process industries will be one of increasing acceptance and usage. The basic reason for this will be that in spite of developments to conserve the use of water, or improve the quantity or quality of what is now available, and better to dispose of it after use, all of these will entail increasing expense. Accordingly, the use of air-cooled equipment will become increasingly attractive and more and more applications will be considered and made. Prospective users may make proper allowance for the satisfactory performance record it has already accumulated and consider its usage with confidence that they are not entertaining something which is unproved, but instead will be able to realize the benefits resulting from its having passed through the development stage, and reached the position of reliability in design, construction and performance.

Plant Practices

Practical Tips and Ideas for Improving Operations

Reduced Hazards to Personnel Attained With Pure Oil's Flare Stack Igniter

By E. P. KING and R. B. PAXTON,
The Pure Oil Co., Cabin Creek Refinery

A FLARE for burning waste gas is a common sight near almost every refinery. The purpose of such a flare is to consume any excess gas production which may occur suddenly and cannot be handled by the gas system. Such sudden surges of gas could not be allowed to accumulate in the vicinity of a refinery on account of the possibility of the many sources of ignition and resultant possibilities of a serious explosion.

Under normal circumstances only a small pilot flame is kept burning. This is to insure immediate ignition and combustion of excess gas. It is only when there is a sudden surge in gas production at the units or failure of some part of the gas handling system that a large flame occurs.

In spite of all efforts to keep the pilot flame burning at a low steady level at all times, conditions sometimes arise which cause the pilot flame to go out. This may be due to a shutdown of gas producing units when the pilot flame is deliberately shut off; or it may be due to sudden heavy gusts of wind which blow the flame out or on rare occasions surges of water or steam from the units.

The only fairly successful method of lighting the pilot flame previous to the development of the present method was manually throwing a lighted torch, consisting of oil soaked rag or waste, at the gas outlet of the flare. This was far from a satisfactory method because just where and how far away to stand, was always a question. The accuracy of the tosser had to be reasonably good and there was always a possibility of a sudden surge of gas and liquid, which might throw a spray of flaming liquid over a wide area.

Several mechanical methods of lighting were tried but all proved to be unsatisfactory due to failure as a result of corrosion and warping due to extreme heating.

The present method of lighting the waste gas flare employs an electrical resistance coil to ignite a pilot flame which is fed with natural gas. Ignition is accomplished by manual operation of a switch in the electrical circuit from a safely remote distance. A description of the lighter in some detail follows.

Fig. 1 shows the construction of the device including a diagram of the electrical circuit. It will be noted that the construction is fairly simple and it can be made from material readily available around the refinery. However, there are a few details of construction which experience has indicated should have particular consideration.

In the first place, there should be plenty of clearance between the porcelain and alundum sleeves in the top of the lighter so as not to impede the flow of gas and produce back pressure to interfere with the proper operation of the jet in drawing in air.

In the second place, the gas jet must be properly located and air inlet valve be set to give the proper mixture for easy ignition. It was found necessary to determine and

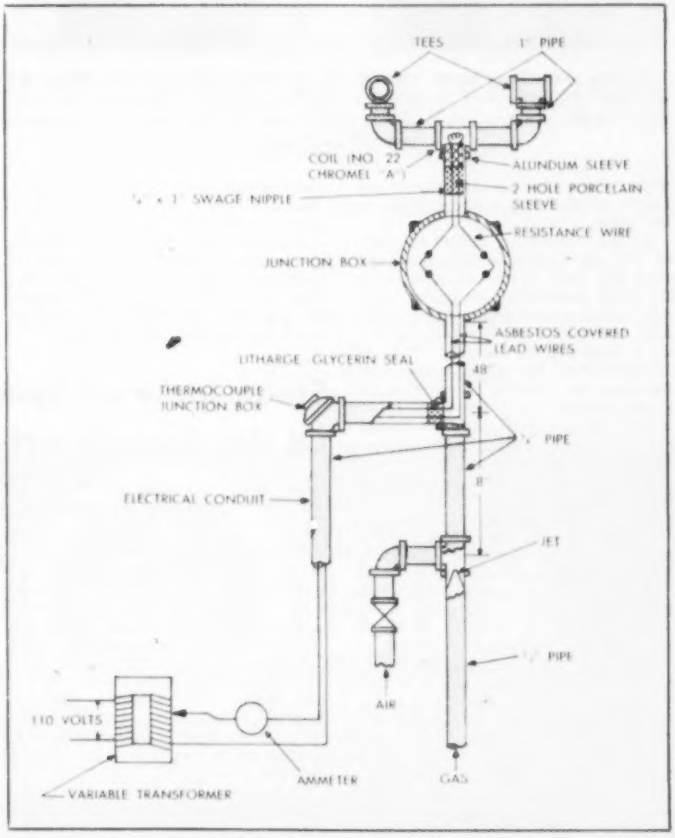
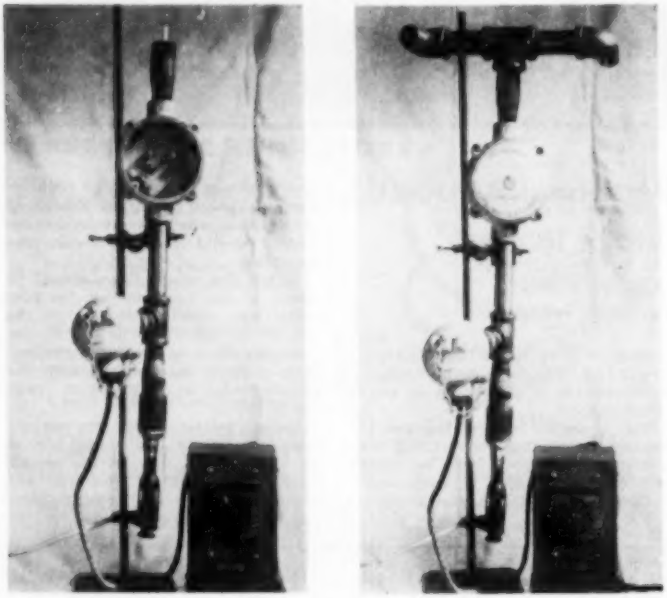


Fig. 1—Details of Pure Oil's waste gas flare stack igniter



Two views of the flare igniter. Left: Chromel resistance wire coil is visible at top of pipe; resistance wire junction box is open; variable transformer at lower right. Right: junction box is closed; pilot flame tee has been put in position over Chromel coil

adjust these factors experimentally before installation of the lighter at the flare.

A coil containing about six feet of No. 22 Chromel "A" resistance wire was used as the hot element in the plant installation. Sufficient voltage is impressed across the resistance to cause a flow of between 7.5 to 8 amperes of current. This is slightly above the rated capacity of the wire, but since it is operated at slight overload for a few minutes at a time the life of the element should not be seriously reduced. Experience has proved this to be true.

The current supply is obtained from the regular 110 volt power supply system through a variable transformer. The flow of current is measured by an ammeter. Undoubtedly other arrangements of the circuit would work just as well, but that shown is what was found most convenient to use in the development of the lighter now in use.

Although extensive efforts were made and considerable experimentation was conducted in attempts to ignite gas when flowing through the lighting apparatus, they were unsuccessful. In order to cause ignition, it is necessary to completely stop the flow of gas and turn on the current to the level required to heat the element to a bright yellow heat and allow a half minute or so for the surrounding space to heat up. Then the gas must be turned on very slowly. Under these conditions ignition will take place inside around the element and the flame will be projected to the outside of the tees. The tees are arranged at right angles to each other to insure at least one tee being sideways to the wind.

The flare lighter has been in operation for more than a year and so far has operated satisfactorily when needed. The only replacement which has been necessary has been renewal of two or three fuses due to exceeding amperage limitations, which were set to protect the heating element.

This development is of particular interest not from the standpoint of its value in increasing production or reducing processing costs, but rather because it has proven to be a satisfactory solution to a serious safety hazard which was evolved after a period of several years experimentation with a wide variety of lighting devices based upon suggestions from a large number of employees.

Flare Stack Series

PETROLEUM PROCESSING's series of Plant Practices items describing the designs by various refineries of waste gas flare stacks and ignition devices—an important factor in air pollution control—was inaugurated in the April issue. Articles that have appeared thus far include:

"No Open Flames or Sparks Produced by Safe Flare Stack Ignition Device," from Humble Oil & Refining Co., Baytown, Texas, April, p. 397.

"Gulf Oil's Flare Stacks Are Designed to Solve Three Important Problems," May, p. 511.

Other companies have made items available for publication in future issues. Watch for them or send in your own!

Steam-jacketed Spout Fills 300 Drums Of Hot Asphalt with One Man Loading

By JOHN M. CONSIDINE, Engineer
Mexican Petroleum Corp. of Georgia, Savannah

IN the process of revising asphalt loading operations at the Savannah refinery of the Mexican Petroleum Corp. of Georgia, the problem was encountered of installing an inexpensive steam-jacketed drum loading spout suitable for outdoor use and capable of loading drums over a wide area. The challenge was answered by producing a loading rig which met these qualifications and in addition was readily operated by one man.

The material to be handled is an oxidized asphalt, which is loaded through a 2½-in. line at temperatures in excess of 400° F. This necessitates widespread coverage with the spout since the drums cannot be moved until the material has solidified. With the rig illustrated in the photograph, 300 drums can be filled in one loading. Fully extended, the spout reaches 21 ft. from the center of the loading area.

A major portion of the materials of construction for the installation were salvaged from plant scrap. The bearings on the vertical column consist of pipe couplings bored out for a slip fit. As shown in the sketch in Fig. 2, a double and a single swing joint provide the necessary flexibility for the rig, while a cantilevered

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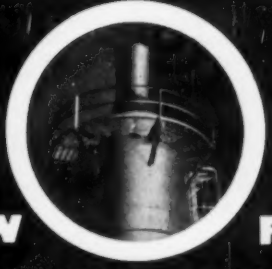

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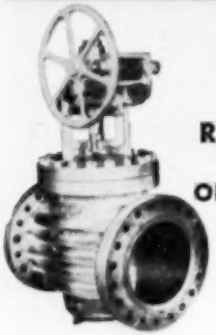

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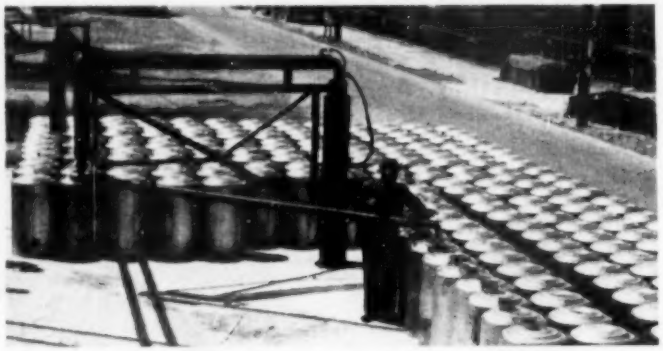

Steam-jacketed loading spout for hot asphalt in use at Savannah plant of Mexican Petroleum Corp. of Georgia

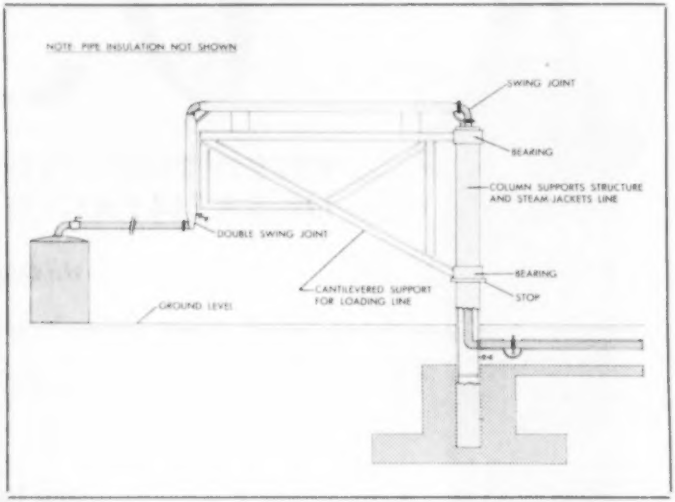

Fig. 2—Schematic arrangement showing method of construction of the asphalt loading rig

"gate" provides the necessary support for the loading line. The vertical column serves not only as a support for the structure, but also as a steam jacket for the line as well.

In the first year of service the loading rig has filled several thousand drums and has required no maintenance aside from the application of a lubrication grease at the swing joints and bearings.

Water Jet Used to Replace Wooden Sludge Skimmers

JETS of water are being used successfully as improved substitutes for the usual wooden skimmers in the removal of surface sludge and cake accumulations in the cooling water oil separator at Cities Service Oil Co.'s East Chicago refinery.

The separator handles only clear, oil free water from the plant cooling system. A gradual accumulation of moss and algae—not sufficient to justify chemical treatment of the cooling water—has in the past caked on the liquid surface in each compartment of the separator. It has been next to impossible to remove this cake manually by conventional wood skimmers. In fact, at one time it was necessary to use a power-operated drag scoop.

Water jets from any conventional hose nozzle have been the solution to the problem, serving to break up the cake and push it to one side. This cake will build up to thicknesses as

[*To obtain more data on advertised products see page* 666]

great as one ft. over a year's time if not removed.

In the East Chicago installation, the separator consists of three rows of five compartments, each about 25 x 30 ft. The entire separator is 125 ft. long and 90 ft. wide. Six plant water system outlets have been placed at strategic locations at the various intersections of compartments so that six 25-ft. long hoses can be used to reach any single compartment. Plant water is at about 40 psi. No special nozzles are required.

Blending of Lube Oils Made Faster With New Drum Unloading Cradle

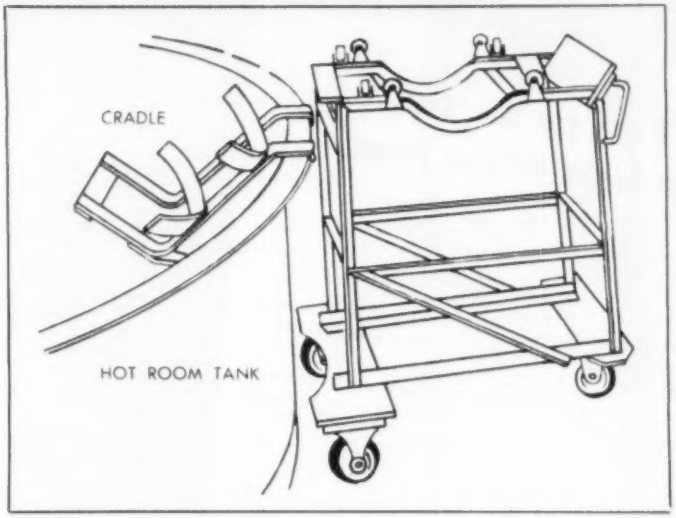

Fig. 3—Handling equipment for unloading drums of viscous liquids into lube oil blending tanks at Tide Water refinery

IN the blending of lubricating oils at the Bayonne, New Jersey, refinery of Tide Water Associated Oil Co., many ingredients are added by emptying standard 55-gal. drum containers directly into the open top blending tanks. The usual procedure was to lift the drum with an air hoist to a mobile dolly, which was rolled to the edge of the tank. The bung end of the drum then was extended over the lip of the tank, the bungs removed, and the material allowed to flow into the tank.

When the drum was nearly empty, it was pushed off the dolly into a light cradle which hung on the inside wall of the tank, and was placed at an angle to allow complete drainage.

Unfortunately many of the ingredients added in this manner are heavy and viscous. Considerable time was wasted waiting for drums to drain to the point where they could be pushed into the cradle, releasing the dolly for use on other mixes.

An improved procedure now employed consists of building a stronger cradle which can receive a fully loaded drum, illustrated in Fig. 3. The previous procedure is followed now except that the full drum is pushed into the cradle immediately, thereby releasing the dolly and the workman for other jobs.

The making of a mix also is speeded up since almost any number of drums may be emptied at the same time, depending only on the availability of cradles. In addition, Tide Water has found an improvement in morale due to the simplification of a rather cumbersome task.

Yellow Signal Banners Cut Maintenance Paper Work

MANY times the "little" jobs around a refinery require more red tape and paper work than they are worth, considering the actual time needed to do them: for example; a broken guard rail, an unwanted pile of dirt that should have been hauled away after some digging job; a leaking pump or fitting out in the tank farm, or a bad section of road-

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way that ought to be leveled off, etc.

Assistant superintendent D. F. Stanfill, Jr., of The Texas Co.'s Lockport, Ill., Works, got a trifle tired of making careful notes of these various little jobs on his periodic trips around the refinery, then transferring these notes to various work orders and memorandums. Most often these little jobs simply went undone, and understandably so. Other assignments on the same work order would take preference because of urgency. This meant repeating the small job assignment on every order until such time that the employee receiving that particular order took the time to go to the specific location designated and perform the 2, or maybe even 10, minute tasks involved.

Mr. Stanfill recently inaugurated a simple idea to circumvent this red tape. It's one of those "why didn't we ever do it before" schemes.

He carries a supply of surveyors' pins in his car. Attached to each pin is a triangular yellow banner of sufficient size to be noticed. He also carries some larger pins made of 4-ft. lengths of old exchanger tubing, sharpened at one end. Whenever he sees an offensive situation or any item that previously he would have written in his notebook, he places the yellow signal in the ground nearby, or he ties a banner on the equipment.

Any maintenance employee who sees the signal can immediately recognize what is wrong, and do something about it. Thus far, the men have taken care of the little jobs on the spot. Then they bring the banner and pin back to their supervisor, who returns it to Mr. Stanfill.

Shortly after starting the scheme, Mr. Stanfill noticed an immediate reduction in the time it took to get little chores done. Eventually, he feels he won't even find places to put the yellow banners at all, because jobs will be taken care of before they happen, or at least before they can be noticed by anyone else.

Have You any Good Ideas?

Plant superintendents, foremen, engineers, chemists, researchers, technicians—Send in your own ideas on "How we do it in our refinery."

Possible subjects could include special apparatus, gadgets, tools, shortcut methods, time and money savers, accident and fire prevention schemes. The idea is the important thing—we'll dress up your drawings or photographs and write up your data. Send your contributions to:

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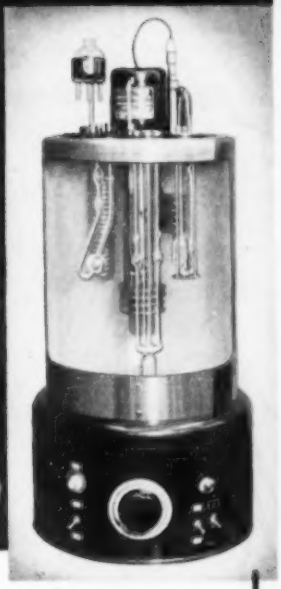

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Patent Trends in Petroleum Refining

By Peter J. Gaylor, Editor "The Technical Survey"

Oil Coking Process Utilizes Steel Pebbles in Chambers

THE coking of oils is facilitated considerably, according to a recent patent issued to Sinclair Refining Co. (U. S. 2,494,695), by the use of steel balls in the coking operation. The coking chamber is filled with metal balls and maintained at 800°-1100° F. and 100-500 psi, whereupon the balls become coated with coke.

These balls are allowed to gravitate downwardly and intermittently through the coking chamber into a lower chamber of about equal pressure, and thereafter, the pressure is suddenly released which causes the coke to break away from the surface of the balls. A coarse screen separates the balls from the coke and gases, and the balls are then recycled by an elevator.

Fig. 1 illustrates the system employed. The returned highly heated balls in chamber 23 are blown with preheated air to remove remaining carbon and, after pressure in chamber 28 is released through line 32, the balls are allowed to fall in this chamber by opening valve 26. After valve 26 is closed, superheated steam is injected into chamber 28 through line 29 until the pressure is higher than that in coking chamber 4, after which, valve 30 is opened and the balls are allowed to drop into coking chamber 4. The oil is charged into the mass of highly heated balls through line 8 and coke is deposited as a layer on the balls, while the vapors and cracked gases are removed through outlet 12.

After the oil stream is shut off, superheated steam is injected through line 10 for the purpose of drying the coke layer. Rotary valve 3 is then turned to open position and the balls are allowed to fall into lower chamber 5. Thereafter valve 3 is closed and the pressure on chamber 5 (caused by injection of superheated steam through line 16) is released suddenly by opening of valve 14, which sudden expulsion of gases causes breaking and peeling off of the coke from the surfaces of the balls. At the same time, the steam is led in through line 16, drying the coke.

The balls and dislodged coke are dropped through rotary valve 7 onto coarse screen 18 over which a stream of water is played from nozzle 21. This washes out all of the coke 19 onto a conveyor, while the balls are gravitated to the bottom of elevator 22.

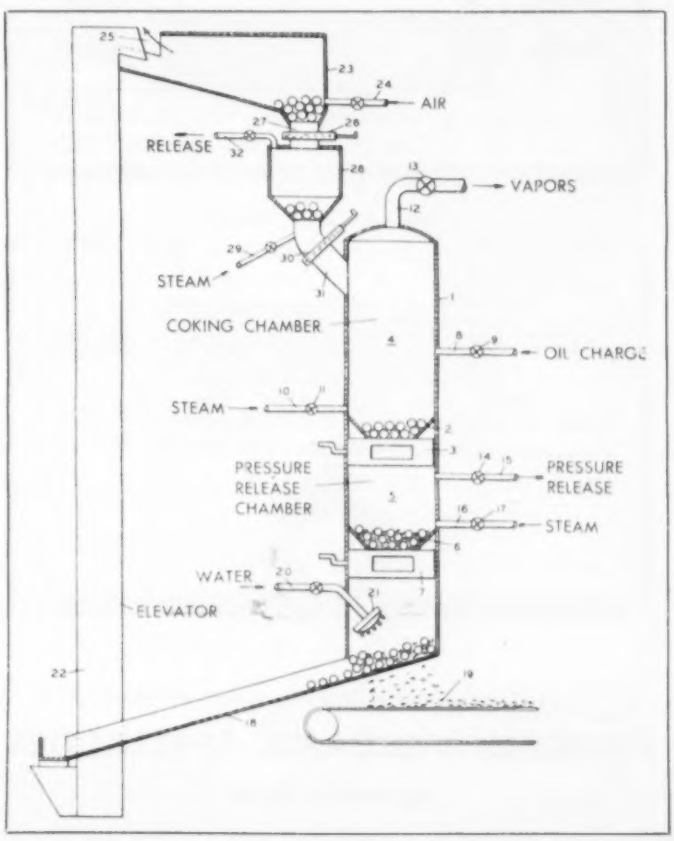


Fig. 1—Diagrammatic arrangement of system using steel pebbles in a petroleum coking process (U. S. 2,494,695)

Multiple Polymer V.I. Additives May Have Abnormal Effects

ACCORDING to one patent issued to Standard Oil Development Co. (U. S. 2,492,789), the use of multiple polymer V. I. improvers may give anomalous results in certain lubricating compositions. For example, when a highly paraffinic solvent-extracted mineral lubricating oil base stock of 43 sec. Saybolt viscosity at 210° F. is blended with a total of 1% polymer and 12% of non solvent (dibutoxyethyl phathalate), results of a thoroughly unusual nature are obtained. In this case, the polybutene was of 12,000 molecular weight, while the polyoctadecyl methacrylate had an average molecular weight of 17,000.

Ordinarily, a linear increase in viscosity index would be expected, in accordance with the dotted line. However, the actual tests showed a sharp rise with a 50-50 polymer mixture, the rise in V. I. being quite appreciable. One theory for the unexpected result is that the solubility characteristics of any one particular polymer are likely to be quite different from the solubility characteristics of almost any other type of polymer not belonging to the same homologous series. Thus each polymer may be considered to have its own character-

istic critical "complete solution or thickening temperature" at which maximum thickening occurs on heating. The presence of non-solvent apparently accentuates this critical condition.

Improving Paraffin Wax

THE tensile strength of paraffin wax is claimed to be increased by addition of 0.1-0.5% of aluminum stearate in which there are at least two stearate radicals per aluminum atom, the stearate being free of acid (Gulf Research & Development Co. U. S. Patent 2,506,059).

Removing Disulfides

IN certain operations, such as copper treating, sweetening by removal of mercaptans often is accompanied by formation of disulfides which remain in the naphtha. Such sulfur compounds, although not as objectionable as mercaptans, are still harmful from the point of view of reducing lead susceptibility, increasing corrosiveness of combustion gases, etc.

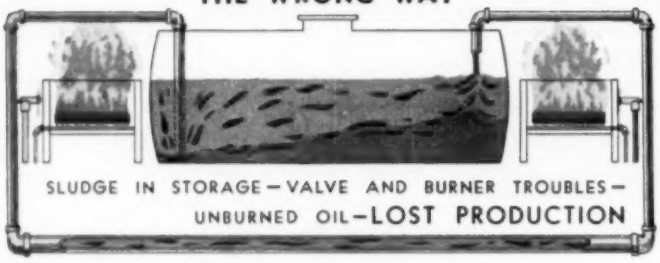
A recent patent issued to Phillips Petroleum Co. claims desulfurization of liquid saturated hydrocarbons containing alkyl disulfides by contacting the hydrocarbons with chlorine, bromine or iodine, whereby the disulfides are converted to the corresponding alkyl sulfenyl halides (U. S. 2,503,486).

Preventing H_2S Corrosion

IN removing hydrogen sulfide with water-soluble organic amines, corrosion of equipment is prevented by adding to the amine solution 10-250 parts per million of a chrom glucosate (U. S. 2,487,578—Phillips Petroleum Co.).

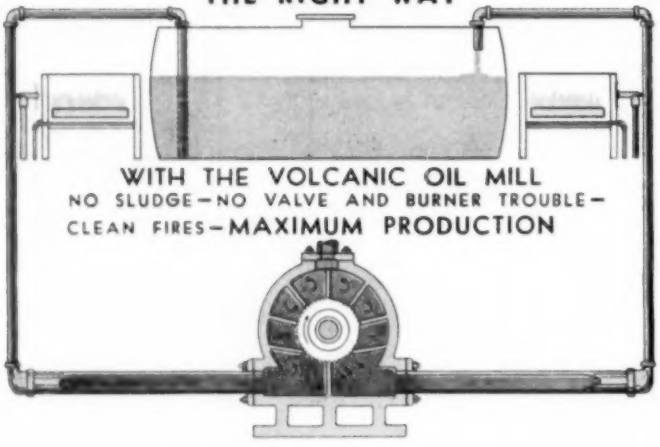
TWO WAYS OF BURNING OIL

THE WRONG WAY



SLUDGE IN STORAGE—VALVE AND BURNER TROUBLES—
UNBURNED OIL—LOST PRODUCTION

THE RIGHT WAY



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CLEAN FIRES—MAXIMUM PRODUCTION

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HOPKINS' VOLCANIC SPECIALTIES

ALLIANCE, OHIO

Patents Issued in April

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for April 4, 11, 18 and 25, Vol. 633, Nos. 1-4.

Fuels

2,502,569 (Universal Oil Products Co.)—Alkylcyclopentane hydrocarbons.
2,502,679 (Shell Development Co.)—Fuel injection system.
2,504,361 (Thompson Products Co.)—Antidetonant injection fuel.

Conversions

2,502,565 (Universal Oil Products Co.)—Isomerizing olefins with metal oxide-silica catalyst.
2,502,953-4 (Standard Oil Development Co.)—Contacting solid particles and gaseous fluid.
2,502,958 (Standard Oil Development Co.)—Simultaneous hydrogenation and dehydrogenation.
2,503,013 (Sinclair Refining Co.)—Pyrolytic conversion of hydrocarbons.
2,503,188 (Socony-Vacuum Oil Co.)—Thermal cracking.
2,503,202 (Socony-Vacuum Oil Co.)—Contacting apparatus.
2,503,291 (Odell)—Promoting reactions in a fluidized bed comprising a plurality of catalysts.
2,503,703 (Socony-Vacuum Oil Co.)—Contactor reactor.
2,504,215 (M. W. Kellogg Co.)—Catalyst chamber.
2,504,280 (Standard Oil Co.-Indiana)—Isomerizing light hydrocarbons.
2,504,415 (Phillips Petroleum Co.)—Catalytic cracking and reforming process.
2,505,644 (Shell Development Co.)—Motor fuels by alkylation (H_2SO_4).

Refining

2,503,014 (Standard Oil Development Co.)—Resolving emulsions.
2,503,119 (Union Oil Co. of Calif.)—Solvent extraction with organic nitrite.
2,503,486 (Phillips Petroleum Co.)—Removing disulfides with halogen.
2,503,528 (Walker et al)—Removal of hydrogen sulfide from gases with iron carbonate, etc.
2,503,627 (Phillips Petroleum Co.)—Copper sweetening of gasolines.
2,503,977 (Standard Oil Development Co.)—Desalting crude.

[To obtain more data on advertised products see page 666]

2,504,058 (Unshuld et al)—Desulfurizing oils by electrical bombardment.
2,504,429 (Phillips Petroleum Co.)—Recovery of hydrocarbons from natural gas.
2,504,464 (Phillips Petroleum Co.)—Control of distillation columns.

Chemicals

2,502,444 (Houdry Process Corp.) — High molecular weight elastic hydrocarbon polymers produced with TEL catalyst.
2,502,506 (Phillips Petroleum Co.)—Reacting hydrogen sulfide with olefins.
2,502,618-9 (Pure Oil Co.)—Purifying alkanesulfonic acid and salts.
2,502,644-5 (California Research Corp.) — Aliphatic esters of cyclohexadiene dicarboxylic acids.
2,502,934 (Shell Development Co.)—Stabilization of sulfolanyl ethers.
2,502,949 (Standard Oil Development Co.)—Dense rubbery compositions.
2,502,978 (Standard Oil Development Co.)—Recovery of secondary alcohols from acid extracts.
2,503,644 (Phillips Petroleum Co.)—Disulfides from mercaptans.
2,503,699 (Shell Development Co.)—Polyallyl acetoxyacetate.
2,504,034 (Standard Oil Development Co.)—Maleic acid from branched dienes.
2,504,051 (Hydrocarbon Research, Inc.)—Oxygen by liquefaction of air.
2,504,068 (Socony-Vacuum Oil Co.) — Octachlorothiolane.
2,504,083-5 (Socony-Vacuum Oil Co.)—Hexachlorothiolane and -ene and oils containing same.
2,504,098 (Shell Development Co.) — Asymmetrical sulfolanyl ethers of heterocyclic alcohols.
2,504,099 (Shell Development Co.)—Cyclohexyl ethers of cyclic sulfones.
2,504,100 (Socony-Vacuum Oil Co.)—Phenol aldehyde resins.
2,504,172 (Phillips Petroleum Co.)—Dealkylation of alkyl pyridines.
2,504,411 (Shell Development Co.)—Separation of alkyl sulfonates.
2,504,488 (Standard Oil Development Co.)—Polymerization reactor.
2,504,618 (Shell Development Co.)—Hydration of olefins to alcohols.
2,504,682 (Shell Development Co.)—Oxygenated compounds.
2,504,148 (Phillips Petroleum Co.)—Drying oils from clay tower polymers.
2,505,204 (Standard Oil Co.-Indiana)—Vinylthiophene polymerization.

Lubricants

2,502,408 (Shell Development Co.)—S-P containing lubricant.
2,503,290 (Socony-Vacuum Oil Co.)—E.P. lubricant containing hexachlorothiolane.
2,503,401 (Standard Oil Co.-Indiana)—Lubricant containing tricarboxy-2-thiabutane.
2,503,749 (The Texas Co.) — Barium soap grease.
2,503,969 (Standard Oil Development Co.)—High temperature soda lubricating grease.
2,504,552 (Tide Water Associated Oil Co.)—Hydraulic torque converter fluid.
2,504,672 (California Research Corp.) — Lithium grease.
2,504,717 (Standard Oil Development Co.)—Reversible lubricating grease composition.
2,504,742-3 (Gulf Oil Corp.)—Antioxidants for mineral oil lubricants.
2,504,779 (Standard Oil Development Co.)—Lubricating grease containing cycalkene polymer.
2,505,222 (Standard Oil Co.-Indiana)—Rosin soap grease.

Hydrocarbon Synthesis

2,503,356 (The Texas Co.)—Synthesizing hydrocarbons.
2,503,724 (Texaco Development Corp.)—Hydrocarbon synthesis.
2,503,963 (Standard Oil Development Co.)—Fischer-Tropsch catalyst.
2,503,964 (Standard Oil Development Co.)—Iron-alkali ferrate catalyst.

Specialties

2,503,246 (Lubrizol Corp.)—Asphalt emulsion.
2,504,270 (Standard Oil Co.-Indiana)—Polyethylene-wax compositions.

Catalysts

2,502,930 (Standard Oil Development Co.)—Catalyst of increased heat stability (alumina-molybdia).
2,503,168 (Davison Chem. Co.)—Alumina gel

2,503,913 (Standard Oil Development Co.)—Drying inorganic hydrogel particles.
2,504,091 (Standard Oil Development Co.)—Silica-vanadia catalyst.
2,504,102 (Socony-Vacuum Oil Co.)—Revivifying clay type sulfur-killed catalysts by burning in low moisture atmosphere.
2,504,158 (Houdry Process Corp.) — Hydrocarbon conversion with Eccles kaolin.
2,505,263 (Phillips Petroleum Co.) — Regenerating a fixed bed catalyst.

Miscellaneous

2,502,568 (Universal Oil Products Co.)—Testing device for thermocouple type temperature recorders.
2,502,682 (Socony-Vacuum Oil Co.)—Measuring activity of radioactive materials.

2,503,187 (Sun Oil Co.)—Pressure relief valve system.
2,503,214-6 (Shell Development Co.)—Extracting penicillin with non-polar solvents.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

MAN FROM MARS?

This queer-appearing fellow might have stepped out of a movie of another world; but actually he is only one of a trained NATASCO Crew. Protected by specially designed clothes, he sandblasts such surfaces of tanks as require this treatment before NATASCO corrosion prevention products are applied. He is just one of a crew of skilled men, with equipment built for each specific task, who will make money for you by protecting your tanks against corrosion.

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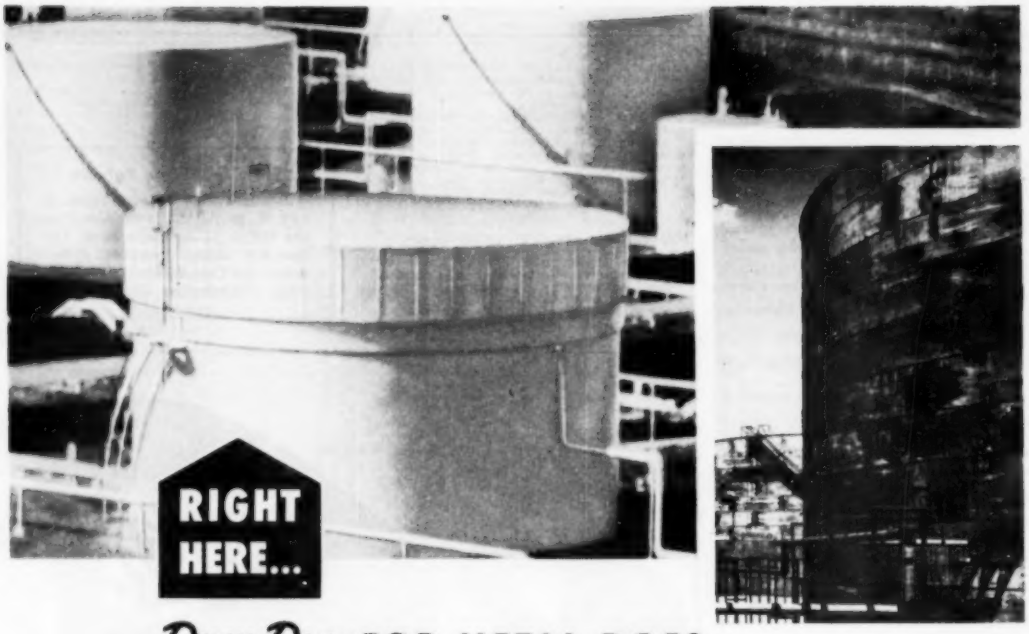
Lease Tank Service—West Texas Area: Williams Construction Company, Odessa, Texas
California Representative: Coast Contractors, Ltd., 4636 E. Slauson, Maywood, Cal.

[To obtain more data on advertised products see page 666]



Dum Dum FOR METAL DOES WHAT PAINT CAN NEVER DO!

This thick, tough, elastic coating (not a paint) stands up against every kind of corrosive element; combats industrial fumes and gases, sun and rain, freeze and thaw for years and years. It does what even the best of metal protective paints (which we make, of course) can never do.

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STAYS PLIABLE — Dum Dum for Metal's outer surface sets up with a tough skin while the undersurface remains pliable and elastic.

HEALS ITSELF — Should Dum Dum for Metal's tough outer surface be bruised or broken, the pliable undersurface skins over where exposed and heals itself.

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Catalyst-Oil Ratio Kept High By Use of Three Strippers

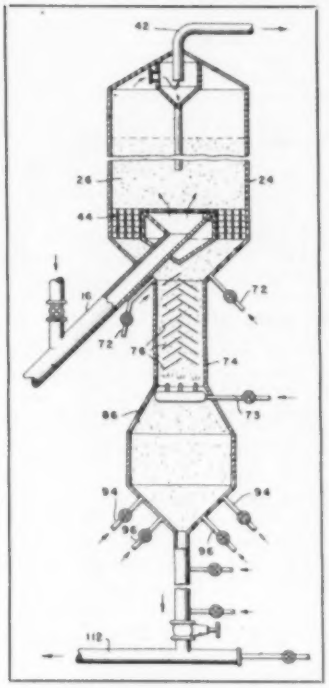


Fig. 1—Fluid catalytic cracking unit incorporating three successive stripping zones 44, 74, and 86 (U. S. 2,502,954)

BY INCORPORATING a series of three successive stripping chambers in its design, a fluid type catalytic cracking unit can be built in which the catalyst-to-oil ratio can be maintained at a high level and still attain efficient stripping with a relatively small volume of steam being used, thus reducing deactivating effects on the catalyst.

The three stripping stages are arranged so that the first section is a high catalyst density-low gas velocity zone, the second section is a low density-high velocity zone, and the third is again at high density and low velocity conditions. One form of the design is illustrated in the cross-sectional drawing in Fig. 1, showing only the reactor 24 with oil feed-catalyst inlet 16, cracked vapors outlet 42, and stripped catalyst outlet 112 leading to the regenerator (which is not shown).

Catalyst flows from the reaction zone 26 downward through the first stripping section 44, which is an annular chamber containing baffles which produce a large number of small diameter cells. Any suitable form of baffles may be used, such as disc and doughnut or egg crate construction. Because of the relatively large horizontal cross-sectional area, section 44 forms a high density-low-velocity zone. Stripping gas velocity is 0.2 to 1.0 ft./sec. Density of the catalyst is 25 to 37 lbs./cu. ft.

Flow is then down through the conical bottom of the reactor to a relatively small diameter second stripping section 74. Some stripping gas may be introduced if desired through lines 72; however, the major portion of the required gas can be obtained through line 73. Baffles 76 in this section 74 are arranged so there is no direct vertical passage. Conditions in the zone are: velocity, 1 to 5 fps.; density, 10 to 25 lbs./cu. ft.

From the bottom of section 74, the catalyst passes to the third stripper 86, into which only small amounts of fluidizing and stripping gas are introduced through lines 94 and 96. Conditions here are: velocity, 0.05 to 0.2 fps.; density, 30 to 45 lbs./cu. ft.

In approximation, the downward flow of catalyst through the three stripping sections is as follows: first, 100 to 300 lbs./sq. ft./min.; second, 200 to 1000 lbs./sq. ft./min.; and third, 100 to 1000 lbs./sq. ft./min.

U. S. 2,502,954, issued April 4, 1950, to Forrest H. Blanding, assignor to the Standard Oil Development Co., Elizabeth, N. J.

Double Pressure Relief Valve Can be Tested while in Place

A DUAL RELIEF VALVE for pressure vessels, such as spheroids for propane, butane, and the like, has been designed so it can be periodically tested and, if necessary, repaired and reconditioned in place without impairing in any way the pressure relief system and the safety of operation.

Fig. 2 illustrates the valve and its operation. A pressure vessel is indicated generally at 10. Two identical pressure relief valves 27 and 28 are connected to a manifold 12 which contains a reciprocating, double-seated plug valve 32, operated by the handwheel *H*. In the position shown in the drawing, valve 28 is in communication with vessel 10, while valve 27 is ready for test or repairs. When plug 32 is shifted to the right, valve 27 goes into communication with vessel 10 and valve 28 becomes available for test.

Ports 41 and 43 are provided for connecting valves 27 and 28, as the case may be, to any suitable pressure test equipment. It will be noted that after any tests and repair work, the function of the system cannot be impaired regardless of the position plug 32 may have within the manifold. If it is not seated in either

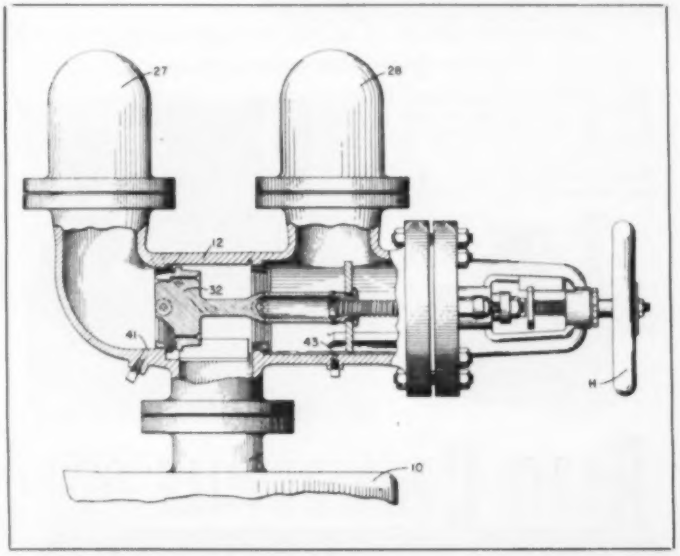
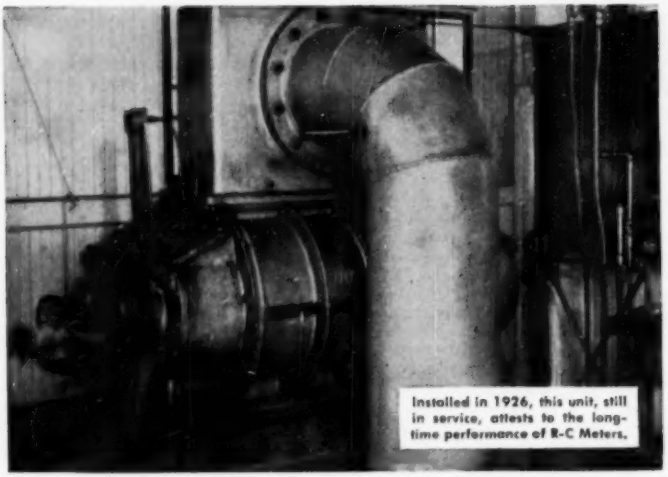


Fig. 2—Double-type pressure relief valve (U. S. 2,503,187)



Installed in 1926, this unit, still in service, attests to the long-time performance of R-C Meters.

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That's a common history of R-C Meters. They're built to measure accurately, and keep on doing it, year after year. Simple design, finely machined measuring surfaces and other important refinements account for their ability to measure gas accurately and unfailingly, almost indefinitely.

With 31 standard sizes and capacities from 4,000 to 1,000,000 cfh, R-C Meters meet the needs of most applications. Write for Bulletin 40-B-14 or tell us your specific requirements.

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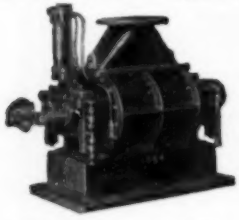
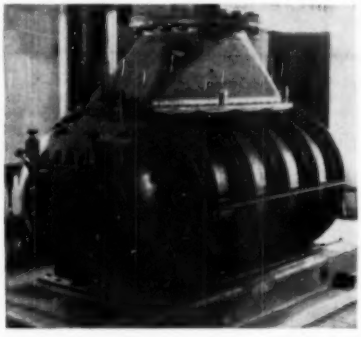
(Right) This R-C Meter, with capacity of 317,000 cfh, replaced the "old-timer" above, now transferred to other duties.

(Below) Typical small capacity R-C Meter for low and medium pressures.





ROOTS-CONNERSVILLE
ONE OF THE DRESSER INDUSTRIES
BLOWER BUILDERS SINCE 1878

valve seat, both valves will be partly open to vessel 10.

U. S. 2,503,187, issued April 4, 1950, to Aaron B. Bagsar, assignor to Sun Oil Co., Philadelphia.

Patents Issued in April

The following classified listing covers patents issued during the month of April believed to be of interest or value to petroleum processing and handling operations:

Catalytic Reactors

2,502,953 (Std. Oil Development Co.)—Apparatus and process for contacting solid particles and gaseous fluid.
2,502,954 (Std. Oil Development Co.)—Apparatus for contacting solids and gaseous fluids.
2,503,013 (Sinclair Refg. Co.)—Apparatus for pyrolitic conversion of hydrocarbons.
2,504,215 (M. W. Kellogg Co.) — Catalyst chamber.
2,504,488 (Std. Oil Development Co.)—Polymerization reactor.

Processing, general

2,503,188 (Socony-Vacuum Oil Co., Inc.)—Apparatus for thermal cracking of hydrocarbons.
2,503,202 (Socony-Vacuum Oil Co., Inc.)—Contacting apparatus.
2,503,228 (Socony-Vacuum Oil Co., Inc.)—Dispersing device of the colloid mill type.
2,503,703 (Socony-Vacuum Oil Co., Inc.)—Reactor.
2,503,788 (The Dorr Co.)—Reactor furnace.
2,505,257 (Phillips Petroleum Co.) — Pebble heater apparatus.

Valves and Fittings

2,502,689 (The Crane Co.)—Retractable gate valve.
2,503,187 (Sun Oil Co.)—Pressure relief valve system.
2,503,469 (Valve Engrg. Co.)—Valve and operating mechanism.
2,503,563 (General Controls Co.)—Valve operator.
2,504,006 (Craig L. Davis) — Combination check, stop, and drain valve.
2,504,057 (The Crane Co.)—Diaphragm valve.
2,504,297 (Lambert J. Bordo)—Plug valve.
2,504,428 (Ruggles-Klingemann Mfg. Co.)—Electrically-operated shutoff valve.
2,504,924 (The Crane Co.) — Conduit gate valve.
2,505,138 (James F. O'Donnell)—Packless self-sealing plug cock valve.
2,505,270 (Cameron Iron Works)—Plug valve.
2,505,376 (Arthur N. Asselin)—Vacuum relief valve.
2,505,410 (C. F. Braun & Co.)—Slide type valve.
2,505,613 (Victor W. Farris)—Safety valve for viscous fluids.

Tools

2,502,660 (Joseph A. McLean)—Device for scribing pipe.
2,502,711 (Thomas J. Evans)—Pipe cutting tool.
2,502,825 (Robert C. Coburn)—Pipe cutter.
2,502,826 (Milton L. Cohn)—Pipe puller.
2,503,042 (Cecil M. Griffin)—Condenser tube cleaner with resilient scraper elements.
2,503,783 (B. M. C. Mfg. Corp.)—Toggle actuated and adjustably mounted pivoted jaw wrench.
2,503,784 (Nathan W. Warman)—Wrench having convex fulcrum-detent quickly shiftable along handle-rack.
2,504,463 (Paul T. Menke)—Gauge line holder and wiper.
2,504,881 (Arthur H. Russell) — Pipe leak clamp.
2,505,723 (Kenneth E. Rees)—Barrel rack.

Instruments

2,502,578 (John I. McDaniel)—Liquid level control device.
2,503,654 (Socony-Vacuum Oil Co., Inc.) — High and low level alarm system.
2,503,660 & 676 (Gulf Research & Development Co.)—Viscometers.
2,505,350 (The Liquidometer Corp.)—Electric telemetering device for liquid levels.
2,505,456 (The Bristol Co.)—Protective apparatus for differential fluid meters.
2,505,693 (Patterson O. Stewart)—Apparatus for analyzing exhaust gases from internal combustion engines.

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There can be no doubt about the liquid level . . . no question whether the gage is empty or full . . . when a Penberthy Reflex Gage is used. The empty space always shows white and the liquid always shows black. It cannot be otherwise because of the unvarying natural law of the refraction of light. You can easily read the Penberthy Reflex Gage as far as you can tell the difference between black and white.

In addition to standard units, Penberthy Reflex Gages are also fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. A complete line of flat glass transparent gages and tubular gages is also available. Penberthy Gages conform with API-ASME requirements. Ask for a copy of new Catalog No. 35.

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[To obtain more data on advertised products see page 666]

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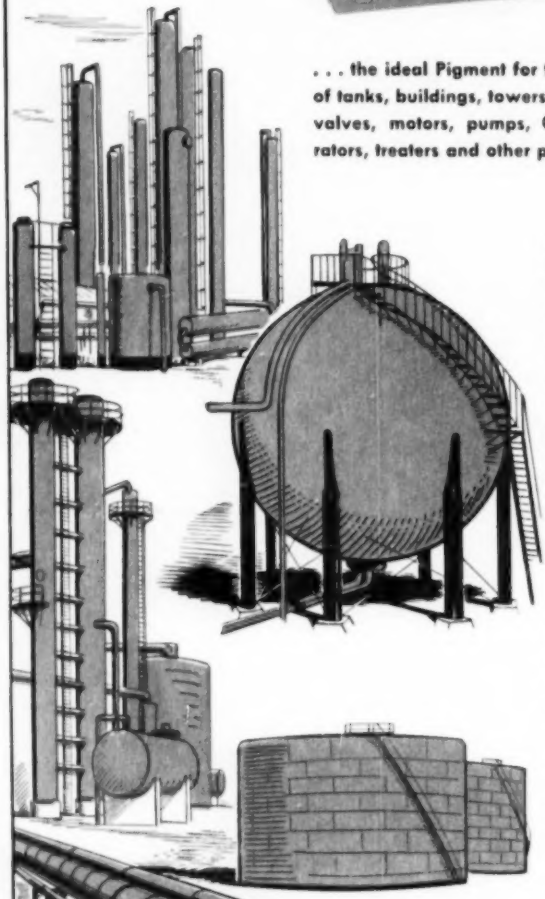
—Greater Heat and Light Reflectivity without Glare...



. . . the ideal Pigment for the aluminum painting of tanks, buildings, towers, power plants, piping, valves, motors, pumps, Christmas trees, separators, treaters and other process equipment.

MD-565W — one of MD's more recent developments, is an all-purpose pigment which dries to a matte-like finish of greater whiteness and brightness, producing a finish of a non-glare type. In the painting of large surfaces (such as tanks) paints formulated with MD-565W Pigment give a smooth finish with a minimum of high lighting.

MD-565W produces films with a suppressed metallic gloss. Its diffuse character approaches as close to a white pigment as is currently possible to obtain with a metallic pigment. It yields films having a specular gloss as low as 60 mils. Aluminum pigments giving films of high specular gloss cannot yield this characteristic whiteness.

MD-565W was designed for the purpose of suppressing the specular characteristic of the usual Aluminum pigment. Its use in petroleum field maintenance painting can make a definite contribution to safety in the industry.

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Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

The Questions and Answers presented here were transcribed from a wire recording of the popular "Information Please" session of the 29th Annual Convention of the Natural Gasoline Assn. of America in Fort Worth, April 26, 1950. Publication is made possible through the cooperation of the various authorities participating, W. F. Lowe, NGAA Secretary, and J. H. Dunn, The Shamrock Oil & Gas Co., Session Moderator.

Cause of Carbon Formation In Engine Intake Ports

What causes carbon in the intake ports of a two cycle engine?

The kind of lubricating oil used seems to be the main factor influencing the rate of carbon formation in the intake ports. Some oils make carbon faster than others. Some oils make a soft carbon. Lube oil is wiped into the intake ports during the passage of the piston rings over the ports. When the ports first start to uncover, hot exhaust gases blow back into the intake for a short time until cylinder pressure is reduced to the presure of scavenging air. This burns the oil present, forming carbon. Then the cool scavenging air forces the exhaust back and eventually out through the exhaust ports.

The rate of carbon formation can be controlled by keeping cylinder lubrication to an absolute minimum and by choosing lube oils that produce a minimum of carbon.

Any carbon which collects in the intake ports should be periodically removed so as to not restrict the flow of scavenging air. Loss of scavenging air results in poor combustion and overheating.—T. O. Kuiviner, The Cooper-Bessemer Corp., Mt. Vernon, O.

Propane as Chilling Agent An Unsafe Plant Practice

Should propane be used as a shrinking agent for steel in making repairs to plant equipment?

The question does not indicate what kind of equipment, but I would like to ask the audience how many do use such a method in a plant?

I happen to know of one case in which there was some trouble in putting the compressor piston rod into a piston. Propane was used to shrink the rod, which was lying on a truck, the propane being supplied as a spray from copper tubing connected to a plant line.

During the operation there was an explosion. Some source of ignition was present. After an investigation, it was decided that the explosion resulted from static electricity ingnition. This, however, never was proven. It never will be known. But there was not supposed to be any source of ignition anywhere around the operation.

Two men were badly burned, one particularly. Personally, I believe it is an unsafe practice. I do not think propane should be used in any way, shape or form for shrinking purposes around a plant where there is any possibility of ignition, or when you have to rely on the human element to keep the propane away from a source of ignition. Instead, liquid nitrogen or carbon dioxide can be used, or the machinery can be taken to a shop to have the job done, if that is practical.

(Discussion from the floor—A plant mechanical representative stated he had successfully used propane to shrink shafts to install bearings on fairly large electric motors. Propane was in abundant supply, special care was taken to work in the open, the crew was in a hurry to get the motors back into operation; it was cheaper to use propane in an on-the-spot job than to take the work to an "outside" shop. All precautions were taken to avoid ignition and an experienced crew was used. Propane was used in open containers rather than sprayed on the work.)

Now there you have both sides of it. Still, I think that any time you use propane, you are following an unsafe practice. In the case I mentioned the men used every precaution, too. There apparently was no ignition source, the men were experienced in all phases of natural gasoline plant maintenance and repair—but still they got caught. We were lucky that one man did not lose his life as a result of burns.

The use of propane for shrinking steel in repair work is one of those things which must be considered carefully where the human element is involved and lives are at stake. It needs to explode but once.

In our case, we had no source of ignition either, but neither did we find out where the static discharge came from. It is very possible something else happened, as in other cases of this kind. But I am sure this is a common practice in many plants, without anyone's realizing the dangers involved. I hope you all will stop this unsafe practice, and not rely on experience.—D. A. Kiemme, Stanolind Oil & Gas Co., Tulsa.

I would like to comment on this business of chilling things with propane.

We, too, have lots of propane in our pipe lines and it is very handy. We usually have 8000 or 9000 bbls. of it in storage.

I would say this to any of you who were working on my job: If I ever caught you chilling a shaft or any other piece of equipment for a shrink job, with propane, you would be looking for another job.

Dry ice always is available; carbon dioxide fire extinguishers always are available. No one in a position of respcnsibility, in my opinion, ever would contest the safe application of a chilling medium against the use of propane or any other volatile and explosive liquid.—S. S. Smith, Shell Oil Co., New York.

Reducing Labor Costs Of Product Pipe Lines

What progress has been made in reducing labor costs at pipe line pump stations and for break-out terminals?

In our work we consider that we are at the irreducible minimum now. We are down to one man on pipe line pump stations. At the moment we are operating no automatic take-off facilities because, in every instance, due to market demands for 24-hour shipment out of terminals, we are attending the terminals at all times. We have on the boards, however, completely automatic terminals which could be operated with a one-man caretaker. If it ever seems economic on small operations to use that type of terminal, we will do so.

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which will operate from the teletypewriter, using the normal communication circuit out of the New York dispatching office. With an ordinary telephone dial, a number is dialed to start the station; another number stops it. A third number for each station can be dialed and the station automatically will report over the teletype its operating pressures and electrical load.

These stations will operate with a one-man caretaker-engineer who will keep the station clean. He will not be subject to call-out at night, so there will be no conflict with the Fair Labor Standards Act or any other of the usual complications encountered in partially-unattended stations. I do not believe a completely manless operation would be satisfactory, except under certain specific conditions.—S. S. Smith, Shell Oil Co., New York.

Choosing Qualified Employes For Gasoline Plants

I would like to have better qualified employes in my natural gasoline plant operations. What do you suggest?

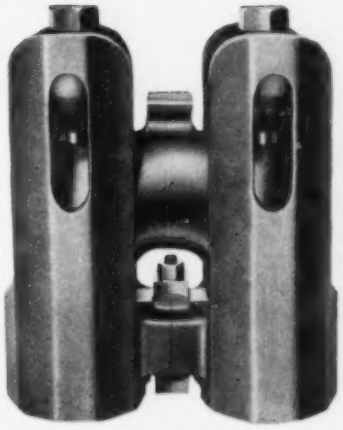
Well there are at least two ways to get better qualified employes. If you've got money enough and can find them on the other fellow's payroll, you can go out and hire them from him. A much better way is to try to develop your own better qualified employes and that starts when they are hired. A lot of our people are hired rather accidentally. For example, we have a construction job or we need an extra man or an extra half dozen men for a few days and we put them on the payroll without giving them very much thought as permanent or regular employes. Then somebody quits and we have a vacancy. One of these men that we hired "accidentally" to do a few days work, goes into the plant as a regular employe. Ten years later we are dissatisfied because he cannot go anywhere.

First, you must start with the employment stage. You must spend more time and give more attention to the quality of the man you hire. Think in terms of what that man will be doing for you a year or five years from now.

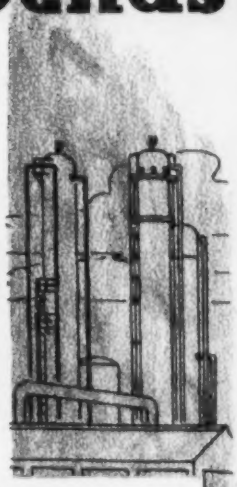
Second, you've got to plan ahead for this man and for all of the others in your plant; work harder towards training. People must be developed if you are to have better people.

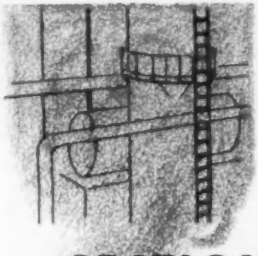
While I am not discussing training especially, I do want to point out that training goes on continuously. A man can be put out in the plant and left on his own; he then is experimenting and learning by experiment. He may blow the plant up before he learns much and my point

OHIO Return Bends



TYPE 2000





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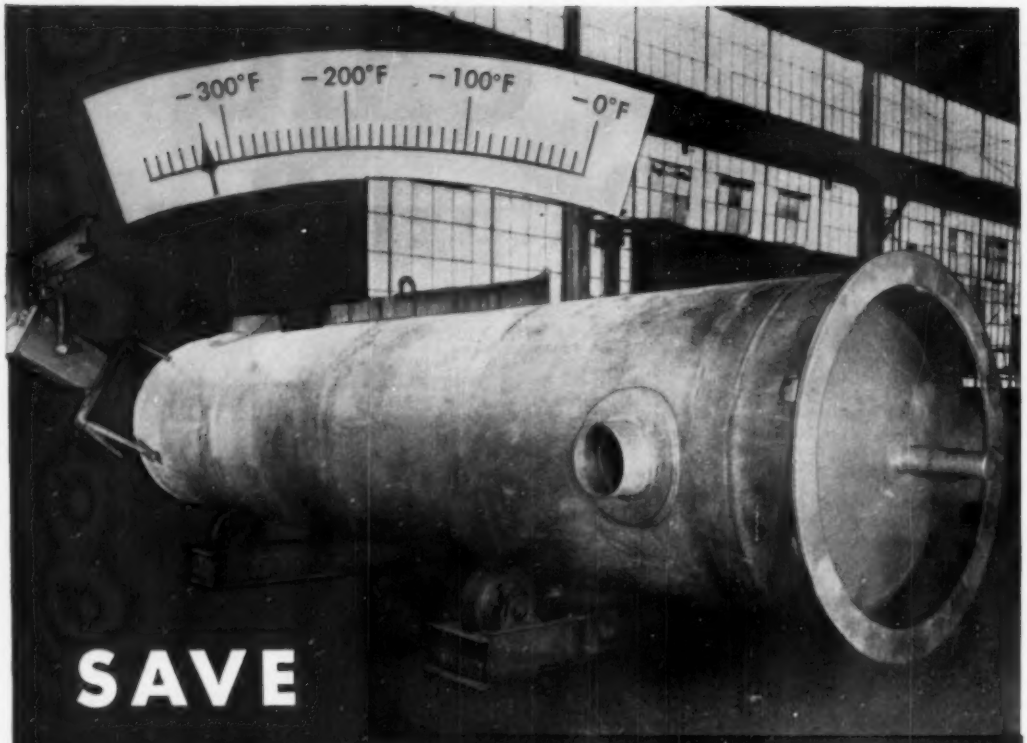

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is that training needs some continuing, conscientious effort.

Training can be from day to day, as the man needs to know somthing to help him understand thoroughly what he is doing and how he should do it; or it can be an organized training plan. Really both are needed.

No single effort will develop employes to where you have those better qualified people. I believe however, that if you will hire better people and pay more attention to your training it won't be necessary to go out and hire the other man's qualified people.—M. V. Cousins, United Gas Co., Shreveport.

Routine Control Tests of Amine-Type Desulfurizers

What routine laboratory tests are necessary to control the operation of a hydrogen sulfide removal unit?

Probably the most important control test is the test on the outlet product, as this tells whether the unit is doing its job of treating the product to the required specification. On gas treating units the lead acetate test is commonly used. This test is mostly qualitative and sensitive to about a 0.25 grain of hydrogen sulfide. The Mines Safety Appliance tester is a handy instrument which reportedly gives a semi-quantitative test in just a few minutes. For a more accurate quantitative test, the gas is passed through a solution of cadimum sulfate, and the precipitated cadmium sulfide is titrated with iodine.

Another important control test is the strength of the solution. This is usually determined by titrating the alkalinity of the solution with standard acid. This about covers the necessary routine laboratory tests for controlling the operations. However, should the outlet product test sour and the solution strength be satisfactory, then further tests are necessary for trouble-shooting.

First, check the solution to see that it is well stripped by titrating the hydrogen sulfide content with iodine. If the solution is not stripped, the likely cause may be a leaky heat exchanger or insufficient heating in the reboiler, although other causes may be possible.

It is advisable to test the solution occasionally for corrosiveness, side-reaction compounds, and decomposition products. This would include tests for thiosulfates, iron content, iron capacity, and, in the case of amine-type absorbents, neutral nitrogen compounds. The Girdler Corp. has a manual of these test procedures.

As to control instruments, we usually meter the gas through the

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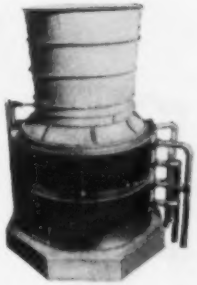

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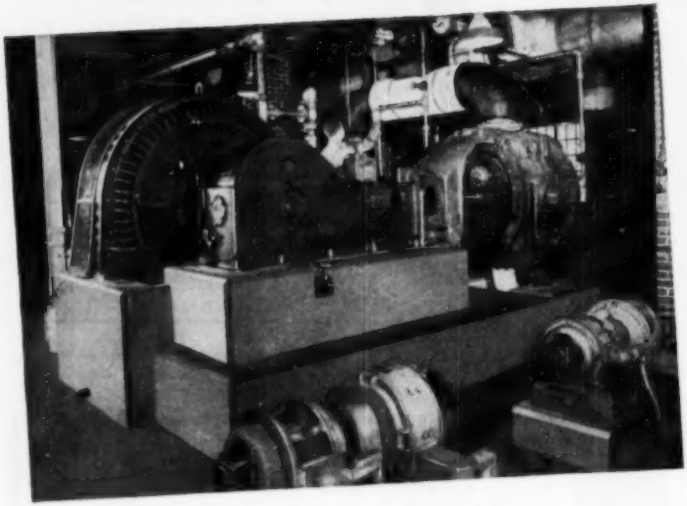

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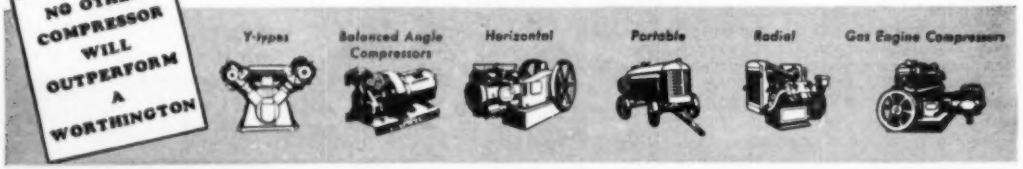

absorber, control the solution flow with a rate-of-flow controller, and control the steam to the reboiler at a constant input. There is no temperature control on the regenerator. Other usual controls include back-pressure on the regenerator and liquid level controls on the absorber and regenerator.

We are considering installing a continuous H_2S recorder on the outlet gas at one of our plants.—A. J. Miller, Phillips Petroleum Co., Bartlesville.

MEETINGS . . . for the Oil Man

JUNE

12-16, American Society of Mechanical Engineers, Oil and Gas Power Division, Conference and Exhibit, Lord Baltimore Hotel, Baltimore.

12-16, American Institute of Electrical Engineers, Summer and Pacific General Meeting, Huntington Hotel, Pasadena.

15-16, Pennsylvania Grade Crude Oil Assn., Annual Meeting, Hotel William Penn, Pittsburgh.

16-17, American Chemical Society, Division of Analytical Chemistry, Third Annual Summer Symposium, Ohio State University, Columbus.

19-22, Chemical Institute of Canada, Annual Meeting, Royal York Hotel, Toronto, Ont.

19-23, American Society of Mechanical Engineers, Semi-Annual Meeting, Hotel Statler, St. Louis.

19-23, Manufacturing Chemists Assn., Annual Meeting, Hotel Monmouth, Spring Lake, N. J.

23, Western Petroleum Refiners Assn., Regional Meeting, Broadview Hotel, Wichita, Kansas.

26-30, American Society for Testing Materials, 53rd Annual Meeting, 9th Exhibit of Testing Apparatus and Related Equipment, Chalfonte-Haddon Hall, Atlantic City.

JULY

3-7, The Institute of Petroleum, Second Oil Shale and Cannel Conference, Glasgow, Scotland.

10-14, Society of Chemical Industry, Sixty-Ninth Annual Meeting, Newcastle-on-the-Tyne, England.

AUGUST

14-16, Third Western Packaging Exposition, Civic Auditorium, San Francisco.

14-16, Society of Automotive Engineers, West Coast Meeting, Biltmore Hotel, Los Angeles.

SEPTEMBER

3-8, American Chemical Society, 118th National Meeting, Chicago.

5-9, American Chemical Society, 6th National Chemical Exposition, Chicago Coliseum, Chicago.

10-13, American Institute of Chemical Engineers, Regional Meeting, Radisson Hotel, Minneapolis.

13-15, National Petroleum Assn., Hotel Traymore, Atlantic City.

18-20, National Butane-Propane Assn., Congress Hotel, Chicago.

18-22, Instrument Society of America, Fifth National Instrument Conference and Exhibit, Memorial Auditorium, Buffalo.

18-22, Joint Conference and Exhibit, **American Society of Mechanical Engineers,** Instruments and Regulators Division, and **Instrument Society of America,** Municipal Auditorium, Buffalo, N. Y.

19-21, American Society of Mechanical Engineers, Fall Meeting, Hotel Sheraton, Worcester, Mass.

25-27, American Society of Mechanical Engineers, Petroleum Division Conference, Roosevelt Hotel, New Orleans.

26-27, American Institute of Mining and Metallurgical Engineers, 1949 Mid-Year Meeting, Neil House and Deshler-Wallick Hotels, Columbus, Ohio.

26-29, Industrial Packaging and Materials Handling Exposition, Philadelphia.

27-30, Society of Automotive Engineers, Aeronautic and Aircraft Engineering Display, Biltmore Hotel, Los Angeles.

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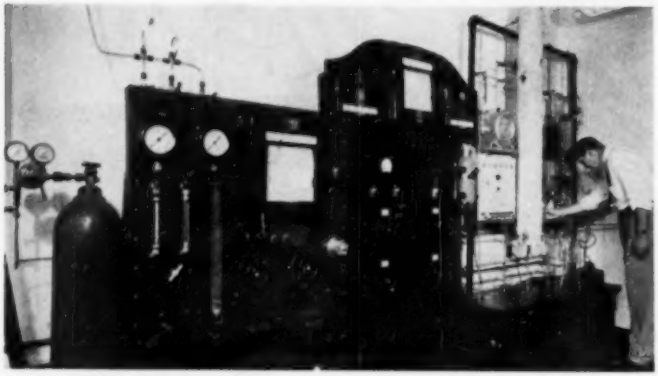
New Research Laboratories for Alcoa in East St. Louis Completed Recently



A laboratory at Alcoa's new research center in East St. Louis where investigations are made for catalytic applications of alumina

A new research building has been completed by Alcoa Aluminum Research Laboratories at East St. Louis, Ill., replacing older facilities in the plant of the Aluminum Ore Co., an Aluminum Co. of America subsidiary. A three-story brick and reinforced concrete structure with 3300 sq. ft. of floor space, it is air-conditioned and has 45% of its outer surface as heat-absorbing glass windows to provide natural lighting.

Among equipment features are an electron microscope, various types of furnaces and converters, complete analytical laboratory, spectroscopic and photographic laboratory. The staff numbers 100. Among research projects under way is the investigation of catalytic applications for alumina.

Clark Increases Turbo Division Staff

Clark Bros. Co., Inc., Olean, N. Y., have announced the transfer of J. E. McCarthy to the Houston office staff, where he will act in the capacity of sales engineer in the Turbo-Machinery Division. The change was necessitated by the increased number of applications of centrifugal compressors in natural gas and petroleum industry, it was said. R. M. Greene, previously in the service department of Foster Wheeler Corp., has been named manager of Clark's Turbo-Machinery Division, succeeding Mr. McCarthy.

Jerguson Merges with British Firm

Jerguson Gage & Valve Co., Somerville, Mass., is now providing service and sales on a world-wide basis as a result of formation of an English company in collaboration with Tress Engineering Co., who have facilities near Newcastle on Tyne in Britain. The new company, Jerguson Tress Gage & Valve Co., has headquarters at Africa House, London. All parts for Jerguson products are being made at both factories and are interchangeable.

Graver Construction Head Dies

Edward B. Heyden, 52, head of Graver Construction Co. and vice president of Graver Tank & Mfg. Co., died at his home in Cranford, N. J. April 18. He had been associated with Graver since 1946. For 14 years previously he was general superintendent for the Lummus Co. and prior to that had served with E. B. Badger & Sons and Tide Water Associated Oil Co. as construction superintendent.

Consolidated Engrg. Builds New Plant

Construction of a modern, half-million dollar plant will soon be under way for Consolidated Engineering Corp. of Pasadena, Calif., it was announced recently. The 66,000 sq. ft. structure will house the administrative, engineering, research, and production departments of the company. It will be located on a five and one-third acre site on South Sierra Madre Villa Avenue in the Hastings Ranch area of eastern Pasadena. Design and construction will be handled by Butress & McClellan, Inc., Los Angeles.

Gen. Campbell Elected to UOP Board

General Levin H. Campbell, Jr. has been elected to the board of directors of Universal Oil Products Co. The executive vice president of International Harvester Co. since 1946, Gen. Campbell was Chief of Ordnance during World War II, and under his direction the armies of the United Nations were supplied with some $50 billion worth of equipment. Following the war, he served as Deputy to the Director of War Mobilization and Reconversion.

Ref'y. Maintenance Opens in Houston

The Refinery Maintenance Co., Compton, Calif., engineers and constructors of refineries and natural gasoline plants, now has permanent offices in Houston, at 4604 South Main St. Purpose of this extension is to bring the company closer to its mid-continent and southwestern clients. Now under work at the new office is engineering and materials procurement for a large gasoline plant RM will erect for Shell Oil Co. at Elk City, Okla.

McNamar Purchases Vulcan Steel Tank

Mr. McNamar

The Vulcan Steel Tank Corp., 3207 Dawson Rd., Tulsa, has been purchased by Charles A. McNamar, Lawrence N. McKelvey, and A. W. Crowley. Vulcan will continue to design and build refinery, gasoline, and chemical plant vessels in all sizes and weights; but in addition, is expanding facilities to serve the production, pipe line, chemical, and marketing fields of the oil industry as well.

Mr. McNamar, in 1932 together with his father, founded the present McNamar Boiler and Tank Co. How-

ever, he disposed of all his interests in that company in 1945, and has had no connection with it since then; although this latter company still operates under the original name.

Nalco Makes Microspheroidal Catalyst

A new supplier of spray-dried microspheroidal cracking catalyst will soon appear in the oil refinery field, according to a recent announcement by National Aluminate Corp. An expansion program at the company's Catalyst Division plant at 4001 West 71st, Chicago, calls for the installation of complete equipment for the manufacture of this product. This will virtually double the overall capacity of the Division, which at present is producing, and will continue to produce, a ground type cracking catalyst.

Kennedy Valve Buys Semler Co.

Purchase of the Semler Co., Jeannette, Pa., manufacturer of cast iron pipe fittings, has been announced by Kennedy Valve Mfg. Co., Elmira, N. Y. Purchase price and future plans were not disclosed, but it was reported that operations would continue at Jeannette. Addition of the Semler Co., with about 220 employes, will augment the Kennedy line of malleable iron and bronze fittings to make it one of the most complete in the fittings industry, it was said.

Personnel Changes

Oil Well Supply Co.—Tommy W. Casey has been appointed manager of the El Dorado, Ark., store, succeeding Frank W. Bruner, Jr., who has transferred to Shreveport, La., as district representative.

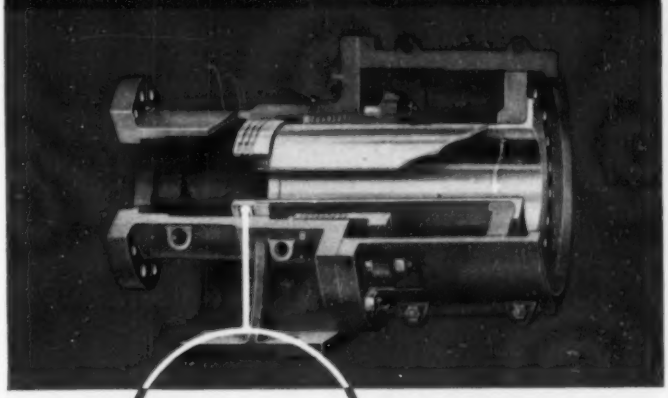
General Refractories Co.—Albert E. Bickell has been appointed assistant district sales manager at the Pittsburgh office. George L. Peck will move from Pittsburgh to the main office in Philadelphia to replace Mr. Bickell.

Crane Packing Co. — Carl E. Schmitz vice-president and director of engineering, was recently elected vice-president-at-large of the American Society of Lubrication Engineers.

Nordstrom Valve Division, Rockwell Mfg. Co.—Charles J. Kentler, Jr. has been appointed applications engineer. With headquarters in Pittsburgh, his assignment will be to cover the chemical, petro-chemical, and allied industries.

Pacific Pumps, Inc.—A. F. Canada, with the company since 1945, has been appointed manager of cen-

Keep pressure IN THE LINES and OFF MAINTENANCE MEN!



ADSCO *Piston-Ring* EXPANSION JOINTS can be packed under full line pressure!

An ADSCO Piston-Ring Expansion Joint pays for itself many times over by eliminating the costly service interruptions and operational losses which naturally result from packing ordinary joints. Your maintenance men can completely repack this joint without shutting off pressure in the lines.

ADSCO's exclusive piston-ring feature—with combined internal guides—holds the line pressure even when the packing is completely removed. Venting the relief chamber exhausts any accumulated steam that may have passed the rings and, with no pressure against the stuffing box, all packing may be withdrawn.

ADSCO'S EXTRA FEATURES include...

NO SCORING OF SLIP because it is in contact only with the packing. The piston rings ride the machined bore of the body.

COMPLETE GUIDING both internally and externally. The external guide is split to facilitate packing and to permit installation in smaller spaces.

LIMIT STOPS prevent over-travel. The slip cannot be pulled from the body while in operation.

PACKING LUBRICATION is provided to prolong packing life and ensure smooth performance of the slip.

NON-FREEZING GLAND STUDS AND BOLTS are of non-corrosive metal and always accessible through special openings in the external guide.

ADSCO Piston-Ring Expansion Joints are available in a full range of sizes, in both single and double units, with 4", 8" or 12" traverse per slip, for pressures to 400 psi and greater, and for temperatures to 750F. and higher. For additional information, see your nearest ADSCO representative or *write for Bulletin No. P-35-15F.*

For an impartial recommendation, ask the company that makes all types of expansion joints . . . ASK ADSCO.

ADSCO

EXPANSION JOINTS — HEAT EXCHANGERS
STEAM TRAPS — STRAINERS — METERS
CASING — ANCHORS — GUIDES

Leaders Since 1877

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N. Y.

[*To obtain more data on advertised products see page 666*]

trifugal pump sales for the mid-continent area, with headquarters in Tulsa. W. R. Carlsen will continue as Houston district sales manager. The following sales engineers have also been named: D. W. Conkling and A. L. Anheier at Tulsa; and W. L. Wathen at Houston.

Cochrane Corp.—Ervin J. Bookout has been named eastern sales manager. He has been with the company for many years as sales engineer in the Philadelphia territory and prior to that in the Cochrane laboratories.

Selas Corp. of America—Anthony J. Potts has been appointed Chicago district manager, with offices at 3857 West Washington Blvd. Before his transfer to Chicago, he was in the main office and plant in Philadelphia.

Expansion, Transition

Process Industries Engineers, Inc., has formed a manufacturing division for the fabrication of engineered equipment for petroleum, chemical, food, and allied industries. The company will continue operations of the engineering and sales divisions at the present location, 5941 Baum Blvd., Pittsburgh 6, Pa.

The Whirl-A-Way Motors plant in Tipp City, Ohio, recently purchased by **A. O. Smith Corp.** for manufacturing fractional horsepower electric motors, will be expanded this summer by a 60,000 sq. ft., $500,000 factory building.

The Filtrol Corp. has moved its national headquarters office to 727 West 7th St., Los Angeles.

De Laval Steam Turbine Co., Trenton, N. J., has appointed Wilkinson & McClean Ltd., of Calgary, Alberta, as sales representative for that province in Canada.

The Industrial Department of the **American Arch Brick Co. Inc.**, New York, has been purchased by the M. H. Detrick Co. American Arch Division, with offices in the Oliver Bldg., Pittsburgh.

Branches, Distributors

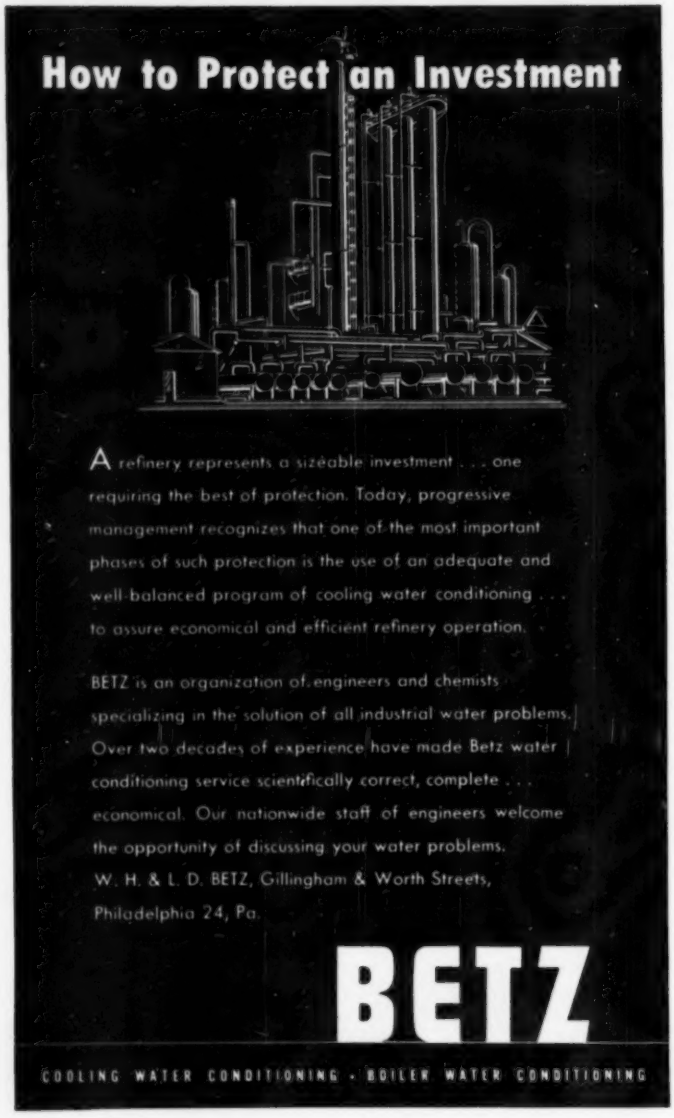
Chiksan Co. has announced the appointment of **George S. Thomson Co.**, 915 S. Central Ave., Phoenix, Ariz., as representative for the state of Arizona.

Hammond Iron Works will be represented in western New York state by the T. F. Killeen Co., 374 Delaware Ave., Buffalo 2.

Childers Mfg. Co., Houston, has named **Metal Goods Corp.** as exclusive distributor for Childers' aluminum weather-proof pipe and vessel jacketing in the mid-west and southwest areas. Metal Goods offices and warehouses are located in St. Louis, Houston, New Orleans, Dallas, Denver, Kansas City, and Tulsa.

Republic Supply Co. has recently opened a new store at Harvey, La., and a sales office at New Orleans. The Harvey story is managed by J. P. Smith II, assisted by M. T. Maloney and W. B. Pattillo. The New Orleans office is located in the International Trade Mart Bldg, and is under the direction of Jack Halbert. Both locations are under the supervision of W. M. Haynes, refinery sales manager for Republic.

The Chicago district office of **Dupont's Petroleum Chemicals Division** is now located in the Willoughby Tower, 8 So. Michigan Blvd., Chicago 3. New telephone numbers are RAndolph 6-8630 and ANdover 3-7000.


How to Protect an Investment
A refinery represents a sizeable investment . . . one requiring the best of protection. Today, progressive management recognizes that one of the most important phases of such protection is the use of an adequate and well-balanced program of cooling water conditioning . . . to assure economical and efficient refinery operation.
BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Over two decades of experience have made Betz water conditioning service scientifically correct, complete . . . economical. Our nationwide staff of engineers welcome the opportunity of discussing your water problems.
W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.
BETZ
COOLING WATER CONDITIONING • BOILER WATER CONDITIONING

Behind: An eventful decade...

Ahead: Strength to meet the oil needs of free people

STANDARD OIL COMPANY (NEW JERSEY) REPORTS FOR 1949...

THE 215,000 STOCKHOLDERS of Standard Oil Company (New Jersey) have just been sent the Company's 1949 Annual Report. Some highlights are given here.

The report covers the closing year of an eventful decade—a decade of violent action and change...of war, and war's results, of great shifts in people's living standards, and in their hopes and aims.

It was a decade which put the strength and adaptability of American business to great tests. *And proved that the American kind of business enterprise gets jobs done.*

To the oil business, these last ten years brought demands far beyond any past experience.

Standard Oil Company (New Jersey) carried well its full share of this load. More new supplies of oil were found and developed than ever before. With them came more new processes, more new products, more new jobs and job opportunities. We took in more money, and paid out more—for wages, taxes, dividends, supplies—than in any previous decade in history. And in that ten years almost four times the amount paid in dividends was invested in new facilities—strengthening the business to meet war and post-war needs.

Like all sound American business, Jersey Standard got these results through skill, initiative, teamwork and the productive use of capital. Men who work in the business of their choice—free to think and make decisions—took actions which got results and got them in time.

In reporting for 1949, this Company offers its stockholders not just the report of one business year...With it comes the hopeful assurance of strength and ability to meet the growing oil needs of free people in free lands.

HIGHLIGHTS FROM THE 1949 REPORT:
(for the consolidated companies)

PRODUCTION—957,000 barrels daily total (11% less than 1948)

REFINING—1,287,000 barrels daily total (7% less than 1948)

SALES—1,363,000 barrels daily (slightly less than 1948)

RESEARCH—$21,400,000 spent on scientific projects (6 per cent more than in 1948)

CONSOLIDATED NET EARNINGS—$268,870,000 or $8.91 a share. This compares with $365,605,000 or $12.44 a share in 1948. Total income $2,934,686,000 (12 per cent less than 1948)

PARENT COMPANY NET EARNINGS—(from which shareholders' dividends are paid) $171,707,000 or $5.69 a share. This compares with $155,923,000 or $5.31 a share in 1948.

DIVIDENDS—$4.00 a share plus one share for each 50 shares held.

EMPLOYEE RELATIONS—Again no work interruption due to labor difficulties.

• • •

Copies of the full report will be gladly sent to anyone wishing full details. Write Room 1626, 30 Rockefeller Plaza, New York 20, New York.

STANDARD OIL COMPANY (NEW JERSEY)
AND AFFILIATED COMPANIES

[*To obtain more data on advertised products see page* 666]

12 BASIC CHEMICALS

ALL *produced by*

MATHIESON

PRODUCED BY OTHER CHEMICAL COMPANIES

PRODUCT	A (MATHIESON)	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
SULPHURIC ACID	✓	✓				✓			✓			✓			✓	✓		
PROCESSED SULPHUR	✓												✓			✓		
SODA ASH	✓			✓						✓	✓						✓	✓
CAUSTIC SODA	✓			✓	✓		✓	✓	✓	✓	✓				✓	✓	✓	✓
BICARBONATE OF SODA	✓			✓						✓	✓							✓
AMMONIA	✓		✓		✓				✓			✓		✓	✓			
AMMONIUM SULPHATE	✓		✓									✓						
NITRATE OF SODA	✓		✓															
CHLORINE	✓			✓	✓		✓	✓	✓	✓	✓				✓	✓	✓	✓
CALCIUM HYPOCHLORITE	✓								✓	✓								
SODIUM CHLORITE	✓																	
CHLORINE DIOXIDE	✓																	

This inclusive selection of basic chemicals—all available from one reliable source of supply—enable Mathieson customers to simplify their purchasing procedures. They benefit further by obtaining chemicals of outstanding purity.

These are but two of the many specific reasons it will pay you to check with Mathieson before ordering any heavy chemical. Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Maryland.

Mathieson CHEMICALS

8350

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

REFINING TRENDS

Building Up Inventories of Heating Oils Is Refiners' Summer Operating Problem

VARIOUS authorities state that minimum requirements for heating oil stocks (kerosine and distillate fuels) in refineries and other primary storage points to start the 1950-51 heating season should be at least equal to that with which refiners entered the 1949-50 season. This would be 118,250,000 bbls. by Oct. 31 for the U. S. and 102,675,000 bbls. east of California. The needs of an abnormally cold winter could be met by increasing the rate of operations as needed, since refineries through last winter ran at around 82-83% of capacity for the most part.

Heating oil stocks in primary storage at the low point of the current heating season, April 30, were 49,700,000 bbls. for the U. S. and 39,615,000 bbls. east of California. These figures contrast with 66,724,000 bbls. and 59,080,000 bbls. respectively for the low stock levels in 1949, which were reached on March 31, a month earlier than this year.

As is shown in Table 1, heating oil stocks in all refining districts, except California and the Rocky Mountain district, were lower on April 30 this year than on March 31, 1949. For the entire U. S., inventories must be built up by 138% from their low point to reach a level of 118,250,000 bbls. for the start of the 1950-51 heating season. For the area east of California, heating oil stocks must be built up this summer by nearly 160%. In the Ind.-Ill.-Ky. district, a stock buildup of nearly 225% will be required to reach the same level as of last Oct. 31.

By way of comparison, in the summer of 1949, U. S. refiners built up their heating oil stocks by only around 77% to reach their Oct. 31 level; east of the Rockies refiners built up their inventories by around 74%. Plants in the Ind.-Ill.-Ky. district a little better than doubled their March 31st storage to reach their level of 20,000,000 bbls. on Oct. 31.

This season not only finds the buildup in heating oils storage starting a month later than in 1949, but also to the end of May this year the buildup for the U. S. has been only around 6,000,000 bbls., while a year ago the increase in inventories during April and May was around 12,000,000 bbls.

To increase their inventories to the 1949 fall level, refiners will likely be faced with increasing their crude runs this summer. In fact, May operations and the recent nominations for increased allowables before the Texas Railroad Commission indicate this trend may be under way. In individual instances refiners may hold up or even increase their distillate yields this summer.

To date this season, however, motor fuel demand is running at a higher rate over 1949 than is refinery gasoline production. The reduction in gasoline stocks during April and May this year has been around 11,750,000 bbls., about double the amount of the reduction in the same period a year ago. Primary gasoline stocks as of the latter part of May were close to the level of 121,600,000 bbls. of May, 1949.

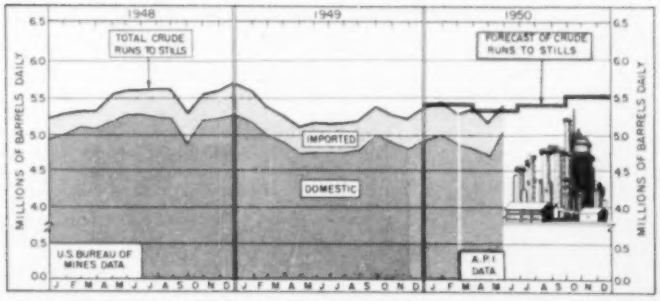
The rate of supply of residual fuels in May was about 6% higher than in May, 1949, due to the large increase in the rate of imports. For the first 4 months of 1950 supply of this product was 4% larger than in 1949. Demand for residual fuels continued through May, and at a higher rate of increase over 1949 than in early 1950. Stocks have been drawn on during April and May, and around June 1 stood at about 39,000,000 bbls. for the U. S. In April and May, 1949, residual stocks were built up over 5,000,000 bbls.

Table I—High and Lows of Heating Oil Inventories (Kerosine and Distillates), 1949-50

Refining District	Low March 31 1949	High Oct. 31 1949	Low April 30 1950*	Difference 1950 Low and '49 High
	(1000 bbls.)			
East Coast	24,100	41,703	14,400	27,303
Gulf Coast	16,186	25,980	11,750	14,230
Inland:				
Appalach.	1,344	1,794	895	899
Ind.-Ill.-Ky.	9,764	20,077	6,190	13,887
Southwest	6,317	10,784	4,655	6,129
Rocky Mts.	1,369	2,337	1,725	612
Total Inland	18,794	34,992	13,465	21,527
Total U. S. Except Calif.	59,080	102,675	39,615	63,060
California	7,644	15,575	10,085	5,490
Total U. S.	66,724	118,250	49,700	68,550

*API Data

Fig. 1, Domestic Runs Reach 5,000,000 b/d


1948
1949
1950
TOTAL CRUDE RUNS TO STILLS
FORECAST OF CRUDE RUNS TO STILLS
IMPORTED
DOMESTIC
U.S. BUREAU OF MINES DATA
A.P.I. DATA
MILLIONS OF BARRELS DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Crude Runs to Stills

	Daily Average (1000 bbls.) Domestic	Foreign	TOTAL
May '50 API*	5,003	474	5,477
May '49 BM	4,783	412	5,195
Change	+220	+62	+282
% Change	4.6	15.0	5.4

* Through May 27

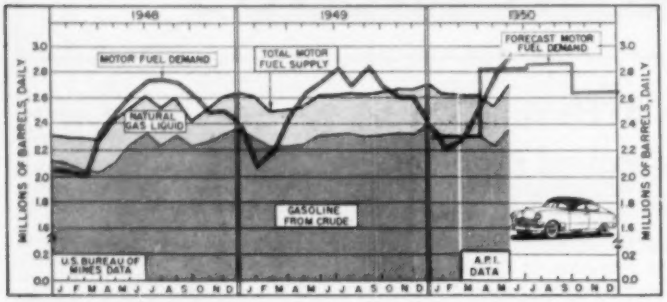
	Total (1,000 bbls.) (Bureau of Mines Data)		
4 Mo. '50*	580,179	54,994	641,173
4 Mo. '49	600,982	47,468	648,450
Change	—14,803	+7,526	—7,277
% Change	2.4	15.8	1.1

* April from API data

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
May '50 API	45.7	5.6	18.6	19.3
April '50 API	43.3	5.6	18.8	21.2
March '50 BM	43.5	6.1	17.7	21.8
May '49 BM	45.1	4.5	15.6	21.8

Fig. 2, Motor Fuel Demand 5% Higher Than '49


1948
1949
1950
MOTOR FUEL DEMAND
TOTAL MOTOR FUEL SUPPLY
FORECAST MOTOR FUEL DEMAND
NATURAL GAS LIQUID
GASOLINE FROM CRUDE
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Natural Gas Liquids include natural gasoline blended at refineries, and used direct as motor fuel.

Fig. 3, Gasoline Stocks Close to 1949 Level

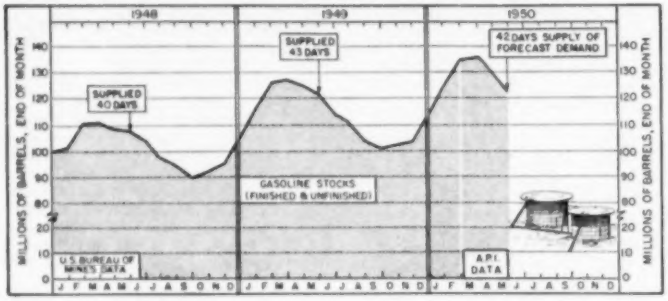

1948
1949
1950
SUPPLIED 40 DAYS
SUPPLIED 43 DAYS
42 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Fig. 4, Distillate Output Holds Up Through May

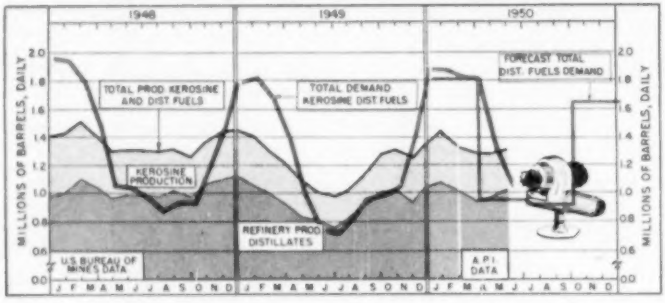
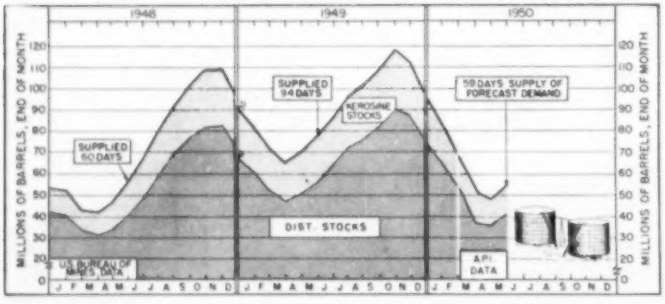

1948
1949
1950
TOTAL PROD KEROSINE AND DIST FUELS
TOTAL DEMAND KEROSINE DIST FUELS
FORECAST TOTAL DIST. FUELS DEMAND
KEROSINE PRODUCTION
REFINERY PROD DISTILLATES
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Fig. 5, Heating Oil Stocks Buildup Half '49 Rate


1948
1949
1950
SUPPLIED 60 DAYS
SUPPLIED 94 DAYS
KEROSINE STOCKS
59 DAYS SUPPLY OF FORECAST DEMAND
DIST. STOCKS
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

* Change in reporting in California eliminated 4,500,000 bbls. from distillate classification.

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
May '50 API*	2,395	320	2,715
May '49 BM	2,352	298	2,650
Change	+43	+22	+65
% Change	1.8	7.4	2.5

* Through May 27

Total (1,000 bbls.)
(Bureau of Mines Data)

4 Mo. '50*	276,631	37,569	314,200
4 Mo. '49	273,950	34,368	308,318
Change	+2,681	+3,201	+5,882
% Change	0.9	9.3	1.9

* April from API data

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

May '50 API*	2,927
May '49 BM	2,769
Change	+158
% Change	5.7

* Through May 27

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '50*	299,096
4 Mo. '49	285,105
Change	+13,991
% Change	4.9

* April from API data

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

May '50 API*	122,757
April '50 API	128,480
March '50 BM	133,796
May '49 BM	121,602

* On May 27

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
May '50 API*	307	1,021	1,328
May '49 BM	237	813	1,050
Change	+70	+208	+278
% Change	29.5	25.5	26.5

* Through May 27

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '50*	40,226	121,939	162,165
4 Mo. '49	36,467	115,413	151,880
Change	+3,759	+6,526	+10,285
% Change	10.3	5.8	6.7

* April from API data

Heating Oils Demand

Including Exports
Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
May '50 API*	189	880	1,069
May '49 BM	157	625	782
Change	+32	255	287
% Change	20.4	40.8	36.7

* Through May 27.

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '50*	47,181	159,765	206,946
4 Mo. '49	41,310	136,795	178,105
Change	5,871	22,970	28,841
% Change	14.2	16.8	16.2

* April from API data

Heating Oil Stocks

(1000 bbls. end of month)

	Kero-sine	Dist. Fuels	TOTAL
May '50 API*	16,075	40,607	56,682
April '50 API	12,900	36,797	49,697
March '50 BM	13,001	37,777	50,778
May '49 BM	21,546	57,442	78,988

* On May 27

Fig. 6, Refinery Output of Residuals at Low Point

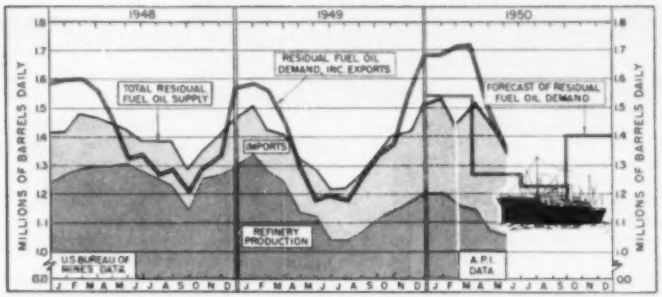
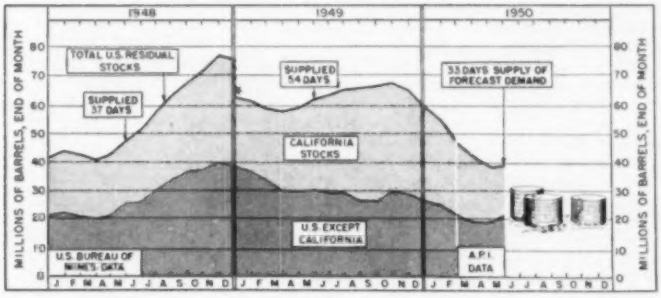


Fig. 7, Little Buildup in "Resid." Stocks in May



* Change in reporting in California eliminated 13,000,000 bbls. from residual classification.

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
May '50 API*	1,060	310	1,370
May '49 BM	1,138	157	1,295
Change	−78	+153	+75
% Change	6.8	97.5	5.8

* Through May 27

Total (1000 bbls.)
(Bureau of Mines Data)

4 Mo. '50*	138,519	40,344	178,863
4 Mo. '49	151,316	19,987	171,303
Change	−12,797	+20,357	+7,560
% Change	8.5	101.8	4.4

* April from API data.

Residual Fuels Demand

Including Exports
Daily Average (1000 bbls.)

May '50 API*	1,365
May '49 BM	1,183
Change	+182
% Change	15.4

*Through May 27

Total Demand (1000 bbls.)

4 Mo. '50*	200,509
4 Mo. '49	177,518
Change	+22,991
% Change	12.9

* April from API data.

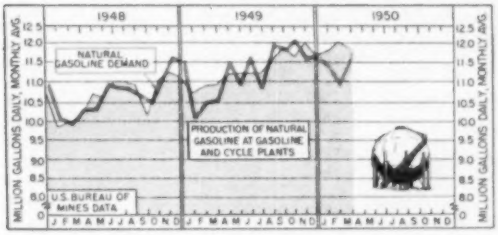
Residual Fuel Stocks

(000 bbls. end of month)

	U.S. Except California	Total U.S.
May '50 API	20,631	39,308
April '50 API	18,770	39,190
March '50 BM	19,423	41,860
May '49 BM	30,760	63,576

* May 27

Fig. 8, Production and Demand of Natural Gas Liquids


1948
1949
1950
MILLION GALLONS DAILY, MONTHLY AVG.
NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

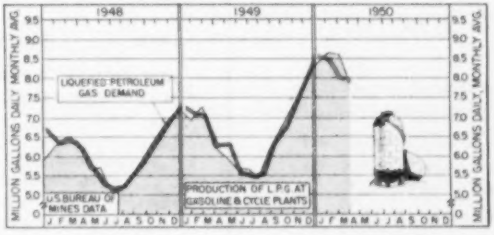
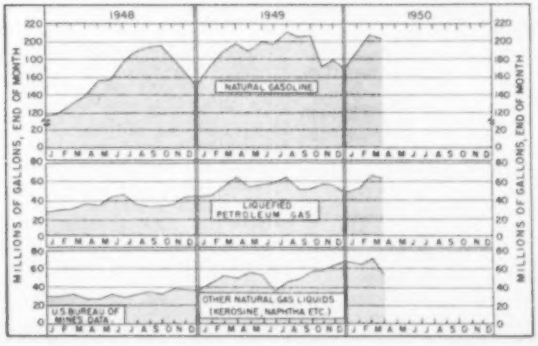

1948
1949
1950
MILLION GALLONS DAILY MONTHLY AVG.
LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF L.P.G. AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Fig. 9, Stocks of Natural Gas Liquids


1948
1949
1950
MILLIONS OF GALLONS, END OF MONTH
NATURAL GASOLINE
LIQUEFIED PETROLEUM GAS
OTHER NATURAL GAS LIQUIDS (KEROSINE, NAPHTHA ETC.)
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Natural Gas Liquids Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

	Production (1000 gal./day avg.) Natural Gasoline	LPG**	TOTAL	Demand* (1000 gal./day avg.) Natural Gasoline	LPG	TOTAL
March '50	11,822	7,917	19,739	11,800	8,020	19,820
March '49	10,850	6,469	17,319	10,700	6,340	17,040
Change	+972	+1,457	+2,429	+1,100	+1,680	+2,780
% Change	8.9	22.5	14.3	10.3	26.5	17.3
	Total Production (1000 gal.)			Total Demand (1000 gal.)		
3 Mo. '50	1,065,966	750,585	1,816,551	1,027,014	743,234	1,770,248
3 Mo. '49	971,866	617,295	1,589,195	941,799	611,435	1,553,234
Change	94,166	133,190	227,356	85,215	131,799	217,014
% Change	9.7	21.6	14.3	9.1	21.5	13.3

	Stocks, End of Month (1000 gal.) By Type of Product: Natural Gasoline	LPG	Other Products†	By Location: Refineries	Gasoline Plants	TOTAL
March '50	204,012	64,511	55,221	74,886	248,858	323,744
Feb. '50	208,510	66,682	71,532	82,572	264,142	346,714
March '49	199,929	62,948	49,043	76,524	234,496	311,020

* Demand, including exports but not transfers, is supplied from receipts from outside sources as well as current production and stock changes. Outside receipts totaled 3,944,000 gals. in March.

** Does not include LPG produced at refineries which in March totaled 30,888,000 gals.

† Includes kerosine, naphtha, specialty and other products.

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card. . .no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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(B) ALLIED CHEMICAL & DYE CORP., SOLVAY SALES DIVISION 600
(C) ALUMINUM CO. OF AMERICA .. 678
(D) ALUMINUM CO. OF AMERICA .. 642
(E) ALUMINUM CO. OF AMERICA .. 597
(F) ALUMINUM CO. OF AMERICA .. 654
(G) ALUMINUM CO. OF AMERICA .. 582
(H) AMERICAN CYANAMID CO. 558
(I) AMERICAN DISTRICT STEAM CO. 650
(J) ARCO CO., THE 646
(K) ATLAS MINERAL PRODUCTS CO. 671
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(M) BABCOCK & WILCOX TUBE CO., THE 573
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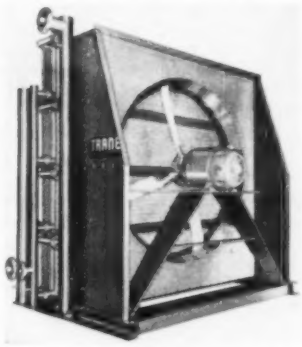
What's New!

EQUIPMENT . . . MATERIALS . . . PROCESSES . . . LITERATURE

Reviewed by WILLIAM C. UHL, Equipment Editor

Standard Air-cooled Exchanger Line Shows Applications in Refining Plants



Among petroleum processing applications recommended for a new line of air-cooled heat transfer equipment are overhead product condensers and steam condensers in refineries. The complete line includes 22 standard production dry type fluid coolers, each consisting of three principal parts: 1) the cooling core, or extended surface heat transfer coil, built up from nonferrous fins and tubes; 2) an especially-designed, balanced propeller fan; 3) a heavy-duty casing built to withstand wind and weather. Capacities of the 22 standardized units range from 66,250 to 7,630,000 Btu./hr. Weights range from 325 lbs. to 9¼ tons. The smallest unit, with an 18-in., one hp. fan, will handle 2,200 cfm. of air and 20 gpm. of water: the largest unit, with a 144-in., 34 hp. fan, will handle 220,000 cfm. air and 1000 gpm. water. The Trane Co.

Circle No. **1** *on Reply Card*

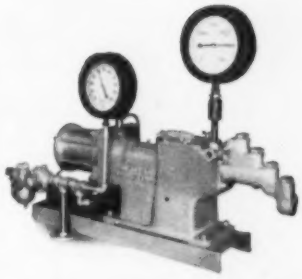
Metal Primer and Rust Destroyer Creates Satisfactory Base for Paint

A liquid primer for metal, "R-10-X," is being made available as a rust destroyer that creates a satisfactory base for paint. Active ingredient of the material is selenium, which combines with iron rust to form a complex iron selenide which dries quickly into a hard, dense substance that is impervious to moisture and holds a paint film well. R-10-X is said to penetrate well below the top surface of the rust and has high spreading power. It can be applied by brush or wiping with a cloth. Thompson-Long Co.

Circle No. **2** *on Reply Card*

Full Automatic Hydrostatic Test Pump Produces Pressures to 25,000 psi.

Suggested applications for the new "AiROYmetric" pump are hydrostatic tests of boilers, pressure vessels, pipe and piping systems, shell and other hollow forgings, vacuum pumps and valves, gages, and the like, at pressures up to 25,000 psi. Double ball-check liquid ends are self-cleaning, non-clogging, and eliminate air binding and wire drawing. Pumps are powered by simple air cylinders with reciprocating pistons. Air cylinder diameters are from 2 to 14 in., with pump plunger diameters from 5/16 to 3½ in. Maximum pressures are obtained by powering small plungers with large air cylinders. Maximum capacities, up to 405 gals./hr., at lower pressures are secured by powering larger diameter plungers by large diameter cylinders. Pump is operated

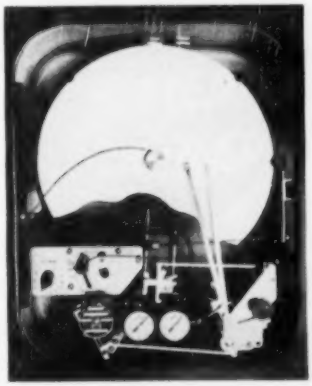


at full stroke length and maximum strokes per minute until predetermined hydraulic pressure in the system is approached. Then the pump automatically slows down to the speed necessary to maintain the required pressure. Self-contained trip valves actuate the air piston; no other controls are employed. No relief valves are necessary. Milton Roy Co.

Circle No. **3** *on Reply Card*

Air-operated Controller Design Points To Low "On-Job" Maintenance Costs

Features of the new Penn Air Operated Controllers, which may be used with the Penn "Magna-Clutch" flow meter, or temperature, pressure, and level recorders, all point to low on-

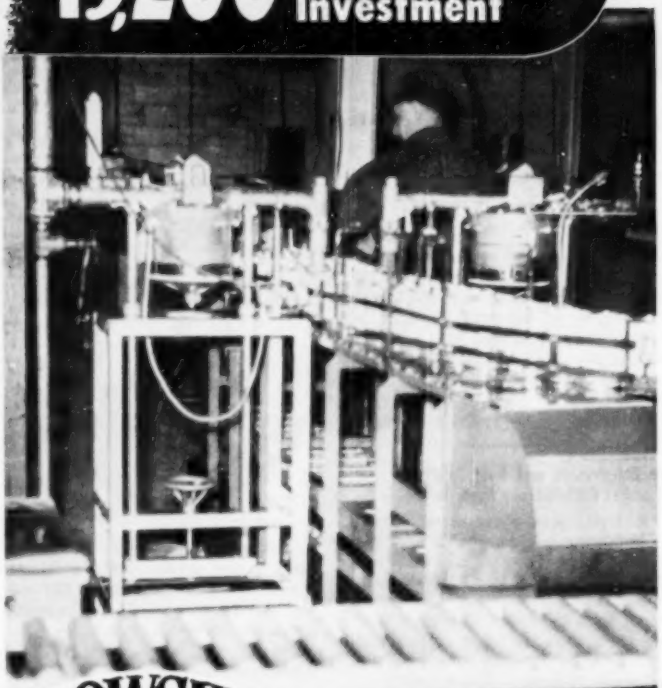


For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

[*To obtain more data on advertised products see page* 666]

43,200 Quart Cans a Day from $2,000 Investment



BOWSER
ESTABLISHED 1885

In an 8-hour day these Bowser twin automatic can fillers are able to turn out 1,800 cases of motor oil—24 quart cans to the case—for a prominent mid-western oil company.*

A single Bowser can filler, which had been turning out 45 quart cans per minute, could no longer meet the demand. Rather than replace this unit with a $16,000 machine to get 60 to 100 quarts per minute, the second Bowser automatic can filler was installed . . . bringing the total investment up to $2,000 and saving $14,000!

Best of all, this doubling of capacity was accomplished with the same number of men.

**Name on request.*

Bowser packaging systems are also available for accurate, fast filling of drums as well as 1, 2 and 5-gallon screw-cap cans.

It might pay you to have a Bowser engineer check your packaging operations.

BOWSER, INC.
1329 Creighton Avenue, Fort Wayne 2, Indiana

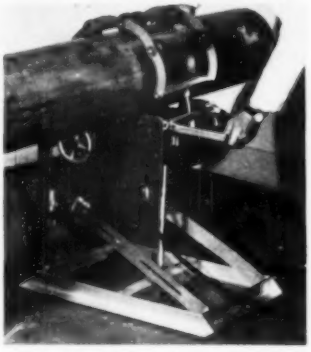
LIQUID CONTROL SPECIALISTS SINCE 1885

What's New!

the-job maintenance costs. Both nozzle and restriction have sapphire jewels to prevent wear due to dirt, water, or oil in the air. The nozzle is fixed, with no adjustment possible. Restriction cleaning lever, accessible from the front, is provided to permit cleaning the restriction while the controller is in service. The relay can be removed separately or with the entire control mechanism by breaking only one tube connection and removing four screws. Tubing connections have been greatly reduced in number from conventional units through the use of channeled passages in the relay housing. The same relay is used for all types of controllers so that control action can be changed in the field. Controllers are available in any of the functions generally required: on-off, proportional control, automatic reset, and derivative action. Penn Industrial Instrument Corp.

Circle No. 4 on Reply Card

Abrasive Wheel Cutter Fast, Accurate For Stainless Tube to 24-in. Diameter



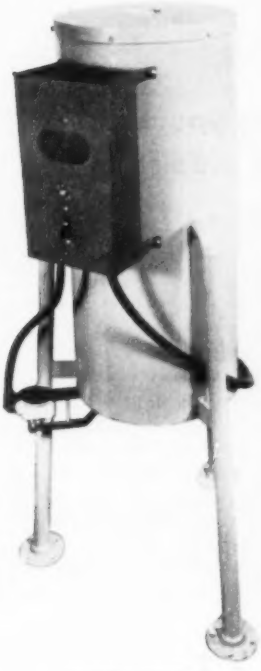
A new portable machine for stainless steel tube cut-off employs an abrasive wheel because properties of stainless alloys are completely lost when such tubing is subjected to blowtorch cut-off methods. Electrically-driven, the machine "walks" around any tube from 4 to 24 in. in diameter and will provide a cut with an accuracy within 0.01 in. When line maintenance and relocation is a factor in a plant using stainless tubing for transportation of corrosive liquids, the laborious hacksaw method has heretofore been the only satisfactory means for cutting the tubing. The new abrasive wheel machine will cut around a 24-in. tube in a matter of seconds, the manufacturer stated. Gilman Engrg. & Mfg. Corp.

Circle No. 5 on Reply Card

Reactor Tube Furnace Permits Study Of Catalysts and Hydrocarbons

A vertical type furnace has been developed to handle laboratory and small pilot plant reactions such as alkylation, dealkylation, pyrolysis, hydrogenation, dehydrogenation, polymerization, and the like. The Model 501 Reactor Tube Electric Furnace is designed for work in petroleum, coal by-product, rubber, plastics, and study of catalysts. It has a range of 100 to 1300° F., using a Chromel A heating element, alundum core. No rheostat or additional equipment is necessary. Unit operates on 220 v., 60 cycle, 6.5 amps. A.C. Overall height is 52 in.; floor to bottom of furnace, 22 in.; heating element, 24 in long. It takes reactor tubes up to 2¼ in. O.D. When smaller tubes are used, stainless steel liners are recommended. Research Appliance Co.

Circle No. **6** *on Reply Card*



Wider Woven Wire Slings Are Useful For Material Handling in Refineries

A line of recently-introduced, woven wire slings has been expanded to meet requirements and possible service in refineries, such as handling heat exchanger tube bundles, rod and bar stock, pipe, and cylindrical tanks. The slings are constructed from an adaptation of a basic wire mesh used in woven wire conveyor belts and now are available in standard widths of 3 to 30 in., and lengths from 36 to 132

in. Other sizes will be supplied on special order. Special tempered steel handles, attached to both ends of the sling, permit use of either a choke or basket hitch around the material being handled. Cambridge Wire Cloth Co.

Circle No. **7** *on Reply Card*

industrial
OIL AND GAS BURNING EQUIPMENT

- Mechanical Atomizing Oil Burners
- Steam Atomizing Oil Burners
- Refractory Burner and Muffle Blocks
- Industrial Gas Burners
- Low Air Pressure Oil Burners
- Fuel Oil Pump Sets
- Valves, Strainers, Furnace Windows
- Tandem Block Combustion Units
- Combination Gas and Oil Burners

Detailed information gladly sent you upon request.

NATIONAL AIROIL BURNER

NATIONAL AIROIL BURNER COMPANY INC.

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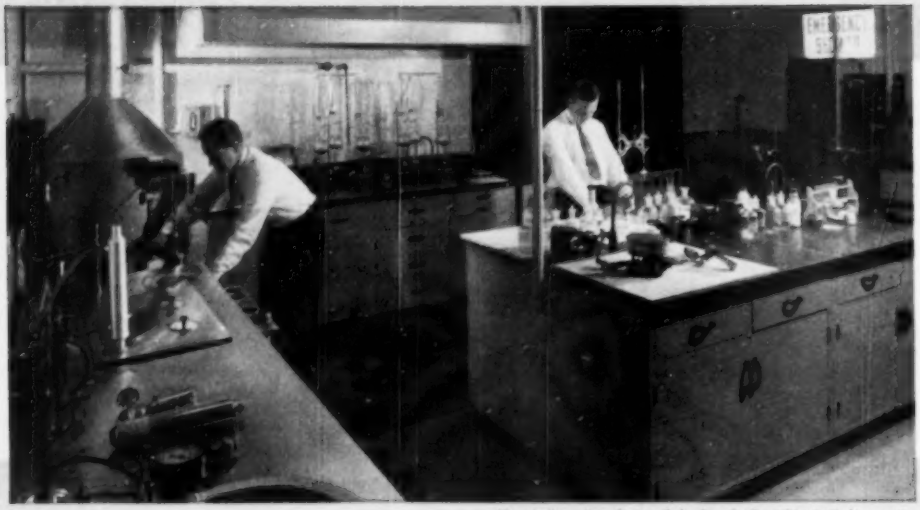
ONLY ONE **MOVING PART..**

A small, stainless steel valve that *floats on the condensate load*...keeps maintenance at a minimum. Continuous discharge under heavy loads, frequent under light loads, *gets equipment hotter, sooner and keeps it hot.* Over 600,000 Yarways already installed. Sold by distributors throughout the world.

YARNALL-WARING CO. 153 MERMAID AVENUE, PHILA. 18, PA.

[To obtain more data on advertised products see page 666]



Chemical section of one of the five Du Pont District Laboratories

BETTER GASOLINE... *more economically*

Your Du Pont District Laboratory can help you with the complete line of Du Pont Gasoline Additives

A 48% reduction in antioxidant treating costs through the use of Metal Deactivator . . . a similar case where a saving of 35% was effected . . . a recommendation for a change in antioxidants which resulted in substantially lowered costs . . . these three cases are typical examples of the services offered by Du Pont Field Laboratories to refiners in their area.

The laboratories provide a comprehensive service on problems involving gasoline quality. These include routine inspections, oxidation stability and TEL response. As a result of these studies, they can frequently recommend one or more additives, from the complete line of Du Pont Gasoline Additives, which will help you produce a better gasoline. There are also numerous case histories where Du Pont Technical Representatives have helped solve troublesome or costly refinery problems through the use of the proper additives at the right place in the refining operation.

To avail yourself of these and other technical services, call or write your nearest Petroleum Chemicals District Office.

DU PONT

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Better Things For Better Living
...Through Chemistry

Petroleum Chemicals

Make Du Pont the Source for All of Your Gasoline Additives . . . Tetraethyl Lead Compounds (Motor Mix—Aviation Mix)—Antioxidants—Metal Deactivator—Dyes

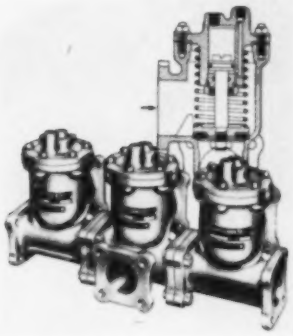
E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

[*To obtain more data on advertised products see page* 666]

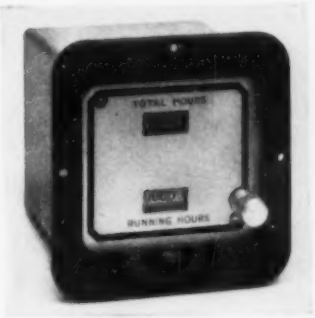
Truck Tank Valve Assembly Permits Automatic Simultaneous Deliveries



Truck-tank delivery compartment valving and dumping is said to be simplified, made safer and more accurate by use of a new Shand & Jurs "Hydrafold" Valve. The manufacturer states deliveries can be handled faster than with manually-operated manifolds. Installation of banked Hydrafold valves permits use of preset compartment selective systems which will handle any desired grouping of compartments simultaneously. The valves are built with 2½ and 3½-in. flanged inlets. Contamination displacement is said to be less than ¾ pint in the smaller size. Installation of the Hydrafold can be in conjunction with or independent of a Shand & Jurs internal hydraulic valving system. Hydraulic pressure is distributed through seamless copper tubing. Fusible elements insure automatic shut-off in case of fire. Shand and Jurs Co.

Circle No. **8** *on Reply Card*

Total and Current Operating Hours Indicated by Running Hours Meter



The Phillips "66" Running Hours Meter, a totally-enclosed, dust-proof, electrical recorder that indicates total and current operating hours on separate counters has applications on industrial time intervals, service and overhaul periods, endurance testing, and the like. Meter will operate in any position and consumes 4 watts of 115 v., 60 cycle power. Weighing 18 oz., it occupies a 3½ x 3½ in. panel space. Each counter registers to 9999.9 hrs. in 6-min increments. A knurled knob is provided to reset running hours. Phillips Petroleum Co., Special Products Div.

Circle No. **9** *on Reply Card*

New Stabilizing Additive Is Developed For Distillate Fuel Oils in Storage

A new inhibitor for retarding sediment formation and maintaining color during the storage of distillate fuel oils has been developed. Marketed as UOP No. 175-6, it is effective in blends of virgin and cracked distillates as well as in the individual components in concentrations as low as 0.002-0.02%. It does not increase Conradson carbon and burns completely, leaving no ash. It has the ability to promote rapid settling of tank bottoms and the sediment with which clean oils are often contaminated when transferred to customers' tanks. The inhibitor is available for laboratory and plant application. Universal Oil Products Co.

Circle No. **10** *on Reply Card*

ATLAS HAS SERVED INDUSTRY OVER HALF A CENTURY

PROBLEMS are SOLVED by
ATLAS
TECHNICAL SERVICE

Over a half century of experience serving industry, an adequately staffed and equipped research laboratory, and a progressive engineering department are all at your disposal through ATLAS TECHNICAL SERVICE. Take advantage of this unique service.

Write us at 19 Walnut Street, Mertztown, Penna.

A COMPLETE LINE OF CORROSION-PROOF MATERIALS

THE ATLAS MINERAL PRODUCTS COMPANY
MERTZTOWN, PENNA. HOUSTON, TEXAS

Cosmopolitan

Badger services have no geographical limitations. Badger-built refineries and processing plants are operating successfully all over the globe, from the deserts of Saudi-Arabia to the jungles of Burma, from Uruguay to Italy. The performance of these plants demonstrates Badger's "know-how" in applying broad experience to petroleum and chemical engineering work anywhere in the world, including adaptations to meet varying climatic conditions.

Wherever your project may be located, Badger will complete the design and procure all necessary materials either in this country or abroad. For the benefit of clients in the sterling area, engineering and purchasing services are provided by our London organization. This allows free choice in the most expedient allocation of currencies.

Facilities can be erected either by our own top complement of construction personnel or by local subcontractors operating under our general supervision and advice.

E. B. BADGER & SONS CO · Est. 1841

A SUBSIDIARY OF STONE & WEBSTER, INC.

BOSTON 14 · NEW YORK

PARIS Etablissements Badger S.A. · LONDON E. B. Badger & Sons (Great Britain) Ltd.

Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries

Photoelectric Recorder Is Developed For Measuring Turbidity Automatically

A new photoelectric recording "turbidimeter" which automatically measures and records the amount of suspended particles in a liquid is said to provide a means for monitoring and controlling processes in water treatment plants or wherever turbidity is a significant condition. It operates on the principle that turbidity of a liquid varies in direct proportion to the ratio of scattered light to transmitted light through the liquid. Results, therefore, are not subject to variations in color of the liquids or voltage supplied to the light source. The equipment comprises a cast bronze sampling chamber to be mounted at the process, and either a strip or a circular chart recorder. The chamber houses three hermetically sealed photo voltaic cells: one to measure transmitted light, and two to measure scattered light. The recording element may be furnished calibrated on the silica scale, or uncalibrated for those who wish to do their own calibration. Scale can be made to read any desired range of turbidity, such as 0 to 10 ppm., 100 to 1,000 ppm., 90 to 100 pp., etc. Instrument operates on 115 v., 50/60 cycle A.C., with a power consumption of about 150 watts. General Electric Co., Special Products Division.

Circle No. **11** *on Reply Card*

3-STEP PLAN TO SAVE MONEY ON CLEANING

Like every thrift-minded executive these days, you are determined to cut your production costs wherever possible. That is why Oakite Products, Inc., offers you the following 3-step Oakite money-saving plan to help you carry out your program of economy.

Step No. 1

CLEANING DRUMS, BARRELS: Use any one of three performance-proved Oakite procedures . . . machine-cleaning; tank-cleaning; steam-detergent cleaning. You'll find each will help cut costs. Each will make possible faster cleaning for quicker re-use. The booklet goes into details. Write for your *free* copy.

Step No. 2

STRIPPING PAINT FROM STORAGE TANKS: Now planning to re-paint storage tank exteriors? To prepare surfaces for anti-corrosion treatment? To clean tank for product changeover? Then your best bet is specialized Oakite cleaning. You'll find facts and figures in booklet. Free on request.

Step No. 3

SALVAGING TOOLS, OTHER EQUIPMENT: Don't scrap used tools, fittings, valves, chains, other things. Chances are Oakite cleaning will make these good as new . . . ready once again to go to work for you. What better way to make a real substantial saving? Write for informative booklet. No obligation, of course.

OAKITE PRODUCTS, INC., 37 Thames St., NEW YORK 6, N. Y.
Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE

Trade Mark Reg. U. S. Pat. Off.

PETROLEUM SERVICE DIVISION

Trade Literature

Refractory Materials

Laclede-Christy Bulletin No. 128A; a six-page folder comprising tabular data on the complete line of refractory products, including softening point, type of container, air or heat set, lbs./1000 brick, wt/cu. ft., acid or neutral, and uses; products include cements and mortars, plastics, castables, coatings, fire brick, silica brick, acid proof brick, and insulating fire brick. Laclede-Christy Co.

Circle No. **12** *on Reply Card*

Cat Cracker Instrumentation

Taylor Technology, Vol. 2, No. 4, Spring, 1950: includes an article on "A Fluid Cat Cracker 'Runs on Instruments'" and another of interest to maintenance personnel on "Shop Facilities for Testing Temperature Instruments." Taylor Instrument Cos.

Circle No. **13** *on Reply Card*

New Plug Valve Design

The Cameron Non-Lubricated Lift-Plug Valve, 16 pages of information on construction of a new plug valve design said to combine advantages of plug and gate valves without retaining their shortcomings; including specifications, etc., in a line from 300 to 1500 lb. ASA class, forged carbon steel, for refineries, pipe lines and general service, in sizes 2, 3, and 4 in. Cameron Iron Works, Inc.

Circle No. **14** *on Reply Card*

High Temperature Stainless Steels

Stainless Steel for Heat Resistance; a 12-page booklet outlining the proper grades of stainless alloys to use for high temperature service; including graphs showing relative scaling resistance, tensile strength, creep strength, high temperature rupture strength; and giving ten general suggestions for selecting proper type for given applications. Armco Steel Corp.

Circle No. **15** *on Reply Card*

Refinery Process Centrifugals

Two Stage, Double Suction Centrifugal Pumps, Type UZD: Bulletin W-318-B21; a four page folder with sectional drawings, dimensions, and a selection chart on a line of pumps ranging in capacity from 1000 to 7000 gpm., at heads from 400 to 1350 ft., and designed for refinery process, boiler feed, or pipe line services. Worthington Pump and Machinery Corp.

Circle No. **16** *on Reply Card*

Welding Fittings, Flanges

Seamless Carbon Steel Welding Fittings, Forged Steel Flanges, Catalog wf-1950: an 88-page working catalog with standard schedules on specifications, list prices, sizes, dimensional tolerances, thread standards and practices, service pressure ratings; also sizes and wall thicknesses of welding fittings in other metals such as stainless steels, and many alloys. Grinnell Co., Inc.

Circle No. **17** *on Reply Card*

Refinery Construction Costs

Cost Control in the Engineering and Construction of Refineries and Natural Gasoline Plants, a 16-page booklet about cost control and price responsibility as worked out and executed by the Refinery Maintenance Co., Inc.

Circle No. **18** *on Reply Card*

Steam, Air, Gasoline Traps

Nicholson Steam Traps, Catalog No. 250; 32-page illustrated bulletin covering thermostatic steam traps for pressures to 225 psi.; expansion steam traps for pressures to 250 psi.; weight-operated traps for steam, air, gasoline for pressures to 1500 psi.; piston-operated steam traps for pressures to 650 psi.; including charts and formulae for sizing. W. H. Nicholson & Co.

Circle No. **19** *on Reply Card*

Air and Gas Flow Meters

Selas Flo-Scope Flow Rate Indicators for Air and Gas, Bulletin SC-4.1; 8 pages describing construction and operation, and including a selection table, on flow meters used on such applications as measuring gas input rates to burner manifolds on a tube still. Selas Corp. of America.

Circle No. **20** *on Reply Card*

Differential Pressure Transmitter

Hagan Differential Master Sender, High Pressure Type, Bulletin 2150; describes a pneumatic instrument used as metering element in measuring or control of steam, gas, and liquid flow, liquid level, pressure differential, and similar applications over a range from 50 in. water column to 150 psi. at static pressures to 2500 psi. The Hagan Corp.

Circle No. **21** *on Reply Card*

Anti-Corrosion Coatings

Coro-Gard Brand Protective Coatings for Metal is a new pocket-size folder containing 28 samples of various types of paints to prevent corrosion by such factors as sour petroleum products, chemical fumes and spillage, fresh or salt water, spray, or high humidity. Minnesota Mining & Mfg. Co.

Circle No. **22** *on Reply Card*

Two-Metal Tubing Data

Duplex Tubing, Technical Bulletin No. 1950; 12 pages of technical data, recommended methods of installing to prevent galvanic corrosion, and other information on tubing made of two different metals or alloys inside and outside for such applications as exchanger tubes, boiler tubes, chemical and petro-chemical processing.

Controlled Odorization

IN NATURAL GAS DISTRIBUTION

with the New Consolidated

TITRILOG

CONSOLIDATED TITRILOG
Model 26-102

Accurate control of the odorization of natural gas is a major problem facing many gas distribution companies today. The importance of odorizing gas to a known and fixed level, in order to assure its safe and economical distribution, is ever increasing with the rapid expansion of natural gas utilization.

The Consolidated Titrilog is now being used in production plants and on distribution lines to continuously record the concentration of the odorant in the stream. Thus, a constant odor level in the gas is insured and a permanent record is acquired for legal evidence of effective odorization.

The Titrilog quantitatively records sulfur compounds such as H_2S, SO_2, mercaptans, thioethers, thiophene, and organic disulfides in concentrations as low as 0.1 ppm or 0.005 grains per 100 cubic feet. Compounds of specific interest may be separately determined over a wide range of concentrations.

For complete information on the Consolidated Titrilog and other applications, such as problems in corrosion, sour-gas treating, etc., write for Bulletin CEC-1810-X8.

SPECIFICATIONS

Sensitivity The Titrilog quantitatively records oxidizable sulfur compounds in concentrations as low as one part in ten million or 0.005 grains per 100 cubic feet.

Power Requirements The Titrilog operates on standard 60-cycle 115-volt power. It requires approximately 6 amperes.

Cabinet Dimensions The Model 26-102 Titrilog is housed in a floor-mounted cabinet 66-inches high, 22½-inches wide, and 18½-inches deep. The strip-chart recording milliammeter is mounted at eye level, and directly below it is the control panel.

CEC

CONSOLIDATED ENGINEERING CORPORATION

Analytical Instruments for Science and Industry

620 NO. LAKE AVE. PASADENA 4, CALIFORNIA

[*To obtain more data on advertised products see page* 666]

etc.; combinations including Admiralty, aluminum brass, copper, cupronickel, aluminum bronze, silicon bronze, with steel, stainless, aluminum, Monel, nickel, lead or tin inside or outside. Bridgeport Brass Co.

Check No. 23 *on Reply Card*

Surface Active Wetting Agents

Tergitol Surface-Active Agents, Bulletin F-5900; an 8-page folder giving properties, uses, and specifications of wetting agents, with data on average wetting times for the various Tergitols in acid, base, and salt solutions, along with information on the effects of organic solvents; includes a table for the selection of the most efficient agent for any given application. Carbide & Carbon Chemicals Div., Union Carbide & Carbon Corp.

Check No. 24 *on Reply Card*

Data on over 1000 Kinds of Atoms

Chart of the Nuclides, a heavy paper wall chart measuring 26 x 50 in., printed in checkerboard fashion, giving full information on each of the 96 elements and their isotopes; including such data as the proportion of each isotope that normally constitutes the natural element; if radioactive, the speed at which it decays and the radiations emitted; whether it appears as a product of the fission of Uranium 235; and the thermal neutron absorption or activation cross section; includes an explanatory booklet, *Nuclides and Isotopes.* General Electric Co.

Check No. 25 *on Reply Card*

★ **SIMPLIFIED RING CUTTING — Super Seal can easily be pulled down to any shaft or stem size.**

★ **POSITIVE PACKING IDENTIFICATION — Super Seal styles are clearly marked, each one in a different color.**

For many years, SUPER SEAL No. 3 has been achieving outstanding service records in valves and centrifugal pumps handling oils, solvents and petroleum distillates on refinery applications. It is highly recommended for temperatures to 550° F.

Now, with patented "tape-back" construction, SUPER SEAL is easier to use, easier to identify. It's another special "John Crane" feature to insure perfect packing satisfaction.

It's hard to believe the resilience of "tape-back" SUPER SEAL until you twist it down yourself. Send for a sample and try it.

JOHN CRANE

CRANE PACKING COMPANY

Houston: 6626 Supply Row, Houston 11, Texas
Chicago: 1832 Cuyler Ave., Chicago 13, Ill.
Los Angeles: 140 North Marina Ave., Wilmington, Calif.

Offices in All Principal Cities in United States and Canada

Maintenance Lubrication

Eleven Ways to Cut Production Costs; a pocket-sized primer on lubrication of industrial equipment. Alemite Div., Stewart-Warner Corp.

Check No. 26 *on Reply Card*

Flow Measurement Problems

Republic Remote Reading, Electrically Operated Flow Meters, Data Book No. 702; a 32-page booklet illustrating and explaining flow measurement problems and their solution, describing meter bodies, differential devices and reading instruments, with a special section on wide range and reverse flow. Republic Flow Meters Co.

Check No. 27 *on Reply Card*

Electrical Equipment Maintenance

Care of AC Rotating Equipment, Bulletin O5R7417; 24 pages of a series of articles covering preventive maintenance and machine repairs of electrical equipment, including such topics as drying moist insulation, measuring insulation resistance, bearing clearances, etc. Allis-Chalmers Mfg. Co.

Check No. 28 *on Reply Card*

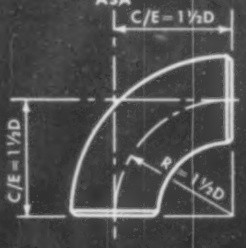
For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

Improvements and economies in welded piping result from this *Variety* of

MIDWEST ELBOWS

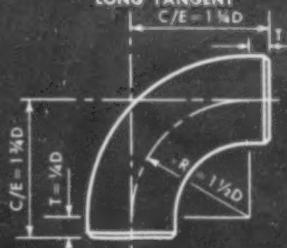
1 LONG RADIUS ASA



SIZES: ⅜" TO 24", INCLUSIVE

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Radius and center-to-end dimension equal 1½ times nominal pipe size.

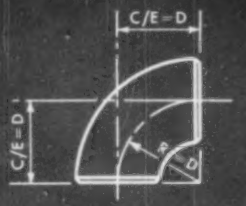
2 LONG RADIUS LONG TANGENT



SIZES: 2" TO 20", INCLUSIVE

Same radius as ASA Elbows but with long integral tangent on each end — an exclusive Midwest feature that saves time and pipe. No price increase over ASA Elbows.

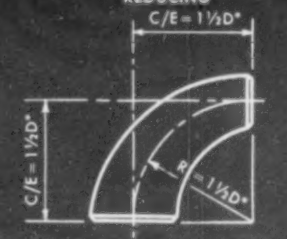
3 SHORT RADIUS



SIZES: 1" TO 30", INCLUSIVE

Where space limitations prevent use of ASA Elbows or Midwest "Long Tangent" Elbows shown above at right, these short turn elbows without tangents are recommended.

4 LONG RADIUS REDUCING



SIZES: 2" TO 12"*, INCLUSIVE

Midwest Reducing Elbow takes the place of a straight elbow and a reducer. It saves more than one-third of the welding and improves both design and appearance.

SYMBOLS { C/E—Center-to-End Dimension; T—Length of Tangent; D—Nominal Pipe Size; R—Radius; *D—Dimension is for larger Pipe Size

MIDWEST WELDING FITTINGS

Improve Piping Designs and Reduce Costs

90° ELBOWS

REDUCING 90° ELBOWS

45° ELBOWS

LAP-JOINT STUB ENDS

REDUCERS

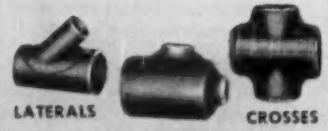
CAPS

SADDLES

SLEEVES

RETURN BENDS

TEES



LATERALS

CROSSES

REDUCING-ON-RUN TEES

SHAPED NIPPLES

FLANGES

The *variety* of Midwest Welding Elbows is particularly important because of the exceptional latitude in design and economy in erection that it provides. For example, the Midwest Long Tangent Elbow permits faster, easier, more accurate lining up with pipe . . . removes weld from point of maximum bending stress . . . often eliminates a short nipple and its extra weld. Slip-on flanges are easily used with minimum change in flange and fitting.

This "Variety" is only one of several reasons why many users prefer Midwest Welding Elbows.

Only MIDWEST offers this VARIETY

MIDWEST PIPING & SUPPLY CO., Inc.

Main Offices: 1450 South Second Street, St. Louis (4), Mo.

Sales Offices: New York (7), 30 Church St.

Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (3), 229 Shell Bldg. • Tulsa (3), 523 Mayo Bldg. South Boston (27), 426 First St. • Distributors in Principal Cities.

Natural Gasoline Corporation dries Propane to minus 50°F Dew Point with ALCOA Activated* Alumina

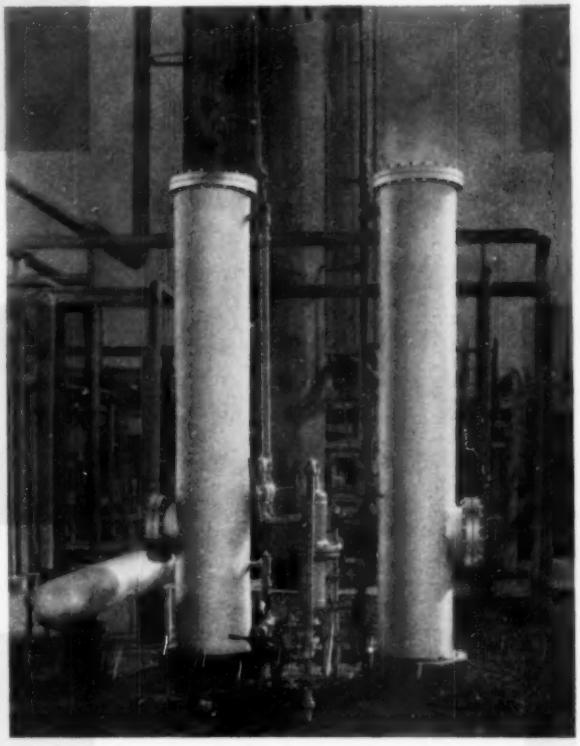
At the Hawkins, Texas, plant, operated by Natural Gasoline Corporation and owned jointly with Humble Oil & Refining Company, you'll find that ALCOA *Activated* Alumina has been drying propane efficiently since 1944. Entering the bottom of the towers at 90° F., 30,000 gallons of liquid propane is dehydrated daily to minus 50° F. at an operating pressure of 200 psig.

The unit operates on a 48-hour cycle, each tower being on stream 24 hours. Regeneration is accomplished in 18 hours by passing natural gas heated to 395° F. through the bed of alumina. Then 6 hours is allowed for cooling.

It is steady, reliable dehydrating performance such as this that has earned for ALCOA *Activated* Alumina a reputation as a dependable, economical desiccant. Commercially pure, it is one of the few solid adsorbents that does not change its form or properties. It will not swell, soften or disintegrate even when immersed in water, nor is it affected by shock or abrasion.

ALCOA *Activated* Alumina is non-corrosive and practically iron-free. It has no effect on the end product even when the two stand in contact for long periods.

If you dry gases, vapors or organic liquids, you'll want *all* the facts regarding this outstanding desiccant. We'll gladly show you how it can solve your particular drying problem. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 616F Gulf Building, Pittsburgh 19, Pennsylvania.



Towers, in service since 1944, dry 30,000 gallons daily.

Alcoa Chemicals

ALCOA

ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM

*Registered Trade-Mark, Aluminum Company of America.

Personals

T. G. Hughes, executive vice president of Oronite Chemical Co., subsidiary of Standard Oil Co. (Calif.), has been elected president to succeed **George L. Parkhurst,** who was elected chairman of Oronite's board of directors. **R. G. Follis,** Standard's board chairman and former chairman of Oronite's board, will remain as director of Oronite.

Mr. Hughes

Mr. Hughes joined Standard in 1926 and has been with Oronite ever since its formation in 1943. He has been executive vice president for the past year.

Mr. Parkhurst is a graduate in chemical engineering of Illinois Institute of Technology and has also received a law degree from De Paul University. He was with Standard Oil Co. (Ind.) prior to the war, and during the war was assistant director of refining with Petroleum Administration for War, later promoted to contract executive in charge of plant approvals, contracts and prices in the 100-octane aviation gasoline program. He was elected president of Oronite in 1946 and a vice president of Standard of Calif. in 1949.

* * *

R. C. Alden, T. B. Hudson, W. A. Schulze and **K. H. Hachmuth** have been selected as members of Phillips Petroleum Co.'s newly established Research Planning Board, formed to facilitate long-term planning of the company's research and development program and to improve its coordination will all company activities. Mr. Alden will be chairman and will report to **G. G. Oberfell,** vice president of Research and Development Dept., through **R. W. Thomas,** manager.

Other assignments in the division include:

P. M. Arnold will assume the new position of assistant to the manager in the Research and Development Dept. **R. L. Doan** will replace Alden as director of the research division with **T. W. Legatski** and **J. A. Reid** as assistant directors.

W. B. Reynolds will be asst. director in charge of chemicals and rubber branch, and **F. W. Crawford** will be asst. director in charge of production and physics branch.

D. E. Carr will be asst. director in charge of combustion and lubrications branch. **F. E. Frey** will be in charge of hydrocarbon conversion branch and **R. W. Blue** has been transferred from production and physics branch to hydrocarbon conversion branch, in charge of fundamental catalysis section. The former fuels and lubricants division has been separated into the hydrocarbon conversion branch and the combustion and lubrication branch.

George Benx remains as manager of the chemical engineering division with **J. P. Jones** as asst. manager. An administration and personnel branch has been established in the Research and Development Dept. to serve the four departmental divisions. **L. C. Morris** has been appointed office manager in charge of the new branch, with **R. R. Couch** as assistant office manager.

* * *

Harry T. Klein, president of The Texas Co., received the honorary degree of Doctor of Commercial Science from New York University on April 11. The presentation of the honorary doctorate to Colonel Klein and other business and financial leaders climaxed a conference which marked the fiftieth anniversary of New York University's school of commerce, accounts and finance.

Mr. Klein

After graduating from McDonald Institute at Bellevue, Kentucky, Colonel Klein practiced and taught law in Cincinnati. He served as 1st Lieutenant and later as Lieutenant Colonel Judge Advocate with the A.E.F. in France from 1917 to 1920. In 1921 he joined The Texas Co. in New York as assistant general counsel. He was made a director and vice president in 1933, and in 1944 was elected president.

* * *

Dr. Wayne E. Kuhn, manager of The Texas Co.'s technical and research division, has been awarded the second Honor Scroll of the New York Chapter of the American Institute of Chemists. The citation, presented at a dinner held on May 24 at the Commodore Hotel, New York, at the chapter's annual meeting, reads: "In recognition of his tireless efforts in advancing the chemical profession, by writing and lecturing, by discussion and by effective organization. His leadership has also contributed greatly to technical advances in the field of petroleum chemistry."

He joined The Texas Co. in 1929 as a chemist and was promoted to his present position, in charge of all technical and research work for the refining division, in 1938. He obtained his B. A. degree from Reed College, Portland, Oreg. and Ph.D. from Cornell University. In 1949 he was chairman of the petroleum division of the American Chemical Society and is a member of many other technical societies and institutes.

* * *

Harry T. Bennett, Mid-Continent Petroleum Corp., Tulsa, and **Dr. Roy G. Story,** Swift and Co., Chicago, have been given the John Scott Award for "Stabilization of Cracked Gasoline." The award includes copper medals and cash premiums of $1,000 for each of the recipients. Presentation was at a dinner meeting of the American Petroleum Institutes refining division at the Hotel Cleveland.

Mr. Bennett was graduated from the University of Delaware in 1915 and received his M.A. degree from Nebraska University a year later. He was a graduate assistant at Nebraska and later served on the faculty at Missouri University. Before joining Cosden & Co., now Mid Continent Petroleum Corp., in 1917, he was a chemist at Oklahoma A. & M. College Agricultural Experiment Station at Stillwater, Okla. In 1919 he became chief chemist for Transcontinental Oil Co., Forth Worth, but returned to Mid-Continent in 1920 as research chemist. He is now technical director.

Mr. Story, LI.B., M.A., Ph.D., was assistant chief chemist at Mid Continent Petroleum Corp. from 1924 to 1928. He became an examiner in the U. S. Patent Office in 1930, leaving to become patent attorney for The Texas Co., New York, until 1939. He now heads the patent division of Swift & Co.

The selection of candidates for the John Scott Award is based on how useful their inventions will be to mankind in the medical, chemical or other fields of science. Previous winners

10,000th A.I.Ch.E.'r

Lewis C. Hulinger, chemical engineer in Indiana Standard's research department at Whiting, Ind., and graduate of Ohio State University, has been cited as the 10,000th member of American Institute of Chemical Engineers.

include such notables as Thomas A. Edison, Orville Wright and Marie Curie.

* * *

M. L. Haider has been elected vice president of Imperial Oil Ltd., and **D. W. McGibbon** has been appointed to succeed the late **Kenneth A. Henderson,** as treasurer.

Mr. Haider is a graduate of Stanford University and after experience in exploration and production, he joined the Standard Oil Development Co. where he was head of the production research and engineering department. In 1945 he joined the Jersey Standard's producing department and in 1946 he became associated with Imperial. Mr. Haider has been a director of Imperial since 1948 and at present is general manager of the company's producing department.

Mr. McGibbon was educated at the University of Toronto and in 1932 he joined Imperial where he worked at the Sarnia refinery and in the manufacturing department in Toronto. In 1940 he was transferred to the comptroller's office. In 1948 he attended the advanced management course at Harvard Business School and later was made assistant to the treasurer at Imperial.

* * *

E. O. Mattocks, technical representative for Phillips Petroleum Co., has joined the American Petroleum Institute as staff engineer in the newly-created department of technical services. Authorized by the executive committee of the Board of Directors early this year, the new department came into official existence on May 1 and is headed by **David Stroop.** Mr. Mattocks will be in charge of engineering and research services.

Mr. Mattocks is a graduate of Cornell University with an M.E. degree. He has been associated with Phillips Petroleum from 1937 until his present resignation to become a member of the API staff. He began there as industrial engineer and served successively as technical assistant to the vice president in charge of patents, administrative assistant to the director of research, and technical representative of chemicals products and chemical engineering department.

Prior to his service with Phillips Petroleum, he worked for American Gas Association Testing Laboratories, Cleveland, and with Syracuse Lighting Co., now the Central New York Power Corp., Syracuse, N. Y.

* * *

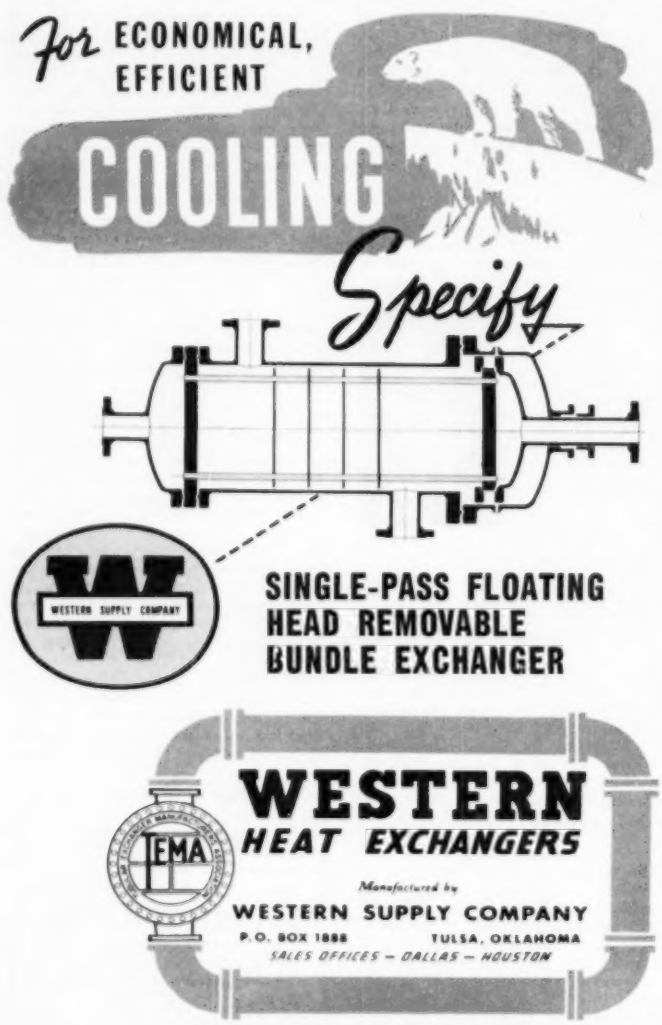
E. V. Murphree, president of Standard Oil Development Co., has been elected to membership in the National Academy of Sciences, which was founded in 1863 and which is composed of leading scientists, engineers and physicians.

Mr. Murphree graduated from the University of Kentucky and was a staff assistant at Massachusetts Institute of Technology. He joined Standard Oil Co. (N. J.) in 1930 as director of a new technical group developing chemical processes for petroleum refining. In 1934 he became director of research and development at Esso Laboratories at Baton Rouge and was later made vice president of Hydro Engineering & Chemical Co., a Jersey Standard affiliate in New York. He became manager of research and development for Standard Oil Development Co. in 1936, vice president in 1938 and executive vice president in 1946.

* * *

A. J. Hartman has been appointed asst. general manager of Gulf Oil Corp.'s employe relations department at their general offices in Pittsburgh. Also newly appointed in the department are **G. L. Scott** as manager of the personnel division and **W. B. Billock** as manager of the labor relations division.

A graduate of Allegheny College and the Wharton School of Business at the University of Pennsylvania,



[*To obtain more data on advertised products see page 666*]

Mr. Hartman was initially employed by the company in Gulf Research & Development Co.'s business management division. He was subsequently promoted to asst. business manager and personnel manager for the research organization, and was transferred to Gulf headquarters to become associated with the employe relations dept. in 1947.

* * *

William F. Brown, general foreman in the lubricating oil division of Continental Oil Co.'s Ponca City refinery has been awarded a 1950-51 Sloan Fellowship at Massachusetts Institute of Technology and will continue to be on company payroll while studying at Cambridge.

Mr. Brown is one of 14 young men from American industry to receive this award to participate in a program of study in business administration and economics. He attended the University of Arkansas but received his B. S. and M.S. degrees in petroleum technology from Tulsa University. He joined Continental as a technologist in 1943 and was promoted to his present position in 1948.

* * *

W. G. Copeland has been appointed superintendent of The Texas Co.'s Eagle Point refinery at Westville, N. J., to replace **A. M. Martin,** who is retiring from active company service. Mr. Copeland previously was assistant superintendent. He was first employed by the company in 1926 as a helper in the laboratory, and after his graduation from Rice Institute in 1927 was hired as a chemist. He was transferred to New York in 1934 after advancing through various posts in the refining department. In 1939 Mr. Copeland was assigned to an affiliate company's refinery in France and in 1943 became assistant superintendent of the company's Sunburst, Mont., refinery. During the construction of the Eagle Point refinery, he was transferred to South Jersey and was appointed assistant superintendent of the plant on June 1, 1948.

* * *

Milton R. Roychok is now chief chemist for the Rothschild Oil Co., Santa Fe Springs, Calif. He graduated in 1946 from Texas A. and M. College and was previously employed as research chemist by Shell Oil Co. and as chemist by General Petroleum Corp.

* * *

Carlos C. Blount, former assistant chief engineer at Deep Rock Oil Corp.'s Cushing, Okla., refinery, has been advanced to the position of refinery safety engineer. **Jon W. Beam,** former supervisor of instruments, has been named development and instrument engineer, and **Robert A. Forsman,** former refinery maintenance supervisor, has been appointed assistant chief engineer to fill the position vacated by Mr. Blount.

* * *

L. B. Wells, manager of Sun Oil Co.'s Marcus Hook refinery, and **Walter Boon,** refinery safety engineer, were presented 60 Pennsylvania Department of Labor & Industry certificates awarded to units within the refinery for their safety record. The awards are made on an accident-free year or better-than-State-average safety record. This is the 18th consecutive year that this refinery has been cited for its safety record.

R. T. Colquette, former director of Pan-Am Southern Corp., has been elected vice president in charge of manufacturing and **Dr. J. W. Bertetti,** technical director of the El Dorado, Ark., refinery, has been appointed manager of that refinery. Other promotions include **H. K. Wheeler,** from assistant technical director to technical director, and **R. R. Gumaer,** who will be technical assistant to Mr. Colquette. Dr. Bertetti and Mr. Wheeler will remain at El Dorado while both Mr. Colquette and Mr. Gumaer will transfer to New Orleans for their new duties.

Refiners Report...

Superior

LUBE OIL, FUEL OIL, GREASE, GASOLINE

through the use of

GLIDDOL

by **Glidden,** *Pacemaker in Soya Research*

Many refiners have already discovered how Gliddol—the scientifically processed soybean derivative by Glidden—reduces surface tension to promote the thorough blending of oil or grease and additives. And from the combined evidence of laboratory tests and the experience of users, they report that this ideal blending agent and inhibitor gives greater protection to engine parts by effectively checking oxidation . . . gives oil and grease a longer life of usefulness by dispersing all insoluble solids.

In the role of protective colloid, Gliddol prevents the formation of any precipitate in leaded and unleaded gasoline—retards deterioration on exposure of the fluid to sunlight. Gliddol R, a special Gliddol product, slows up the darkening of fuel oil and reduces the formation of precipitate in the presence of heat.

Expert guidance on the use of Gliddol and Gliddol products to improve your product is offered without obligation by the Technical Service of Glidden—Pacemaker in Soya Research. Your inquiry is invited.

QUALITY Glidden PRODUCTS

The Glidden Company
SOYA PRODUCTS DIVISION
5165 West Moffat Street
Chicago 39, Illinois

[To obtain more data on advertised products see page 666]

EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Competition of Gas From Coal

DATA as to the competition of gas manufactured from coal with natural gas and petroleum fuels, as recently presented by technologists with the Battelle Memorial Institute, Columbus, Ohio, throw some light on one phase of the problem of making synthetic liquid fuels from coal—the coal gasification step.

After a review of coal-gasifying techniques, the Battelle people came to the conclusion that fuel gas produced at the mines by the cheapest known methods and piped to consuming centers cannot compete with natural gas piped four and six times that far. They believe this situation will last for some time. Moreover, they state there appears to be little chance that gasification of coal can compete with either light or heavy fuel oil at present prices. Even with the possibility some time in the future of a cost of natural gas in markets far removed from gas producing areas of 60c per million Btu they say there must first be a major improvement in coal gasification processes, or substantial declines in the cost of coal.

The Bureau of Mines study of synthetic liquid fuels includes experiments with coal gas synthesis plants. This government agency is completing a gas synthesis demonstration plant at Louisiana, Mo., the coal gasifier of which has been in operation for several months. It will make cost calculations for commercial gas synthesis operations based on the work at Louisiana. The Bureau also reports several coal gasification processes are in the pilot plant stage in its synthetic liquid fuel program.

The Bureau's technologists believe that the cost of the synthesis gas will always be a large fraction (50 to 70%) of the total cost of liquid fuels synthesized from gas made from coal, they state in their annual report to Congress. Technologists in the coal industry believe the cost of gasifying coal must be relatively much lower than this before it will be economically practicable to synthesize liquid fuels from gas made from coal.

The Battelle Institute, whose recently reported research was done on behalf of the coal industry, is talking only of the competition of manufactured gas as such, and not of the further step of synthesizing liquid products from a coal gas. However, its findings indicate that a low-cost coal gasification step is not yet in sight.

The Foundation and Basic Research

IMPORTANT as the matter is to our national welfare, it may still be news to many readers that the National Science Foundation Bill, a subject of controversy in Congress since August, 1945, is now a law. An amended bill as agreed upon by both houses of Congress was passed this spring and signed by the President while he was on his western "nonpolitical" tour. In the welter of other news of the hour with more popular appeal, the signing of the bill received only brief mention.

The law provides for setting up at once a National Science Foundation, which will consist of a National Science Board and Director. The board is to be made up of 24 members appointed by the President for 6-year terms and serving without pay, its members to be eminent in fields of science, education and national affairs.

The National Science Foundation Director is to be appointed by the President, and not until the Board has recommended candidates for this office. The law does not prescribe, however, that the President must follow the Board's recommendations in making the appointment, which must be approved by the Senate. The Director is to serve for 6 years and draw $15,000 annual salary. The manner of selection of the Director, and whether he should be responsible to the scientists on the Foundation Board, or to the President, was the chief point of controversy over the legislation.

The first function of the Foundation, as listed in the new law, is "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in science". This is indeed a most important objective. Basic research as conducted in the schools and in the purely research institutions has traditionally enjoyed the greatest freedom in its pursuits and objectives. Industry and private institutions and citizens have paid the bill in the form of endowments, research fellowships and in other ways. It has trained the nation's scientific manpower and provided the basis for many of our peace and wartime technological developments.

Under an expanded research program, as is envisioned in the National Science Foundation law, a larger part of the funds for basic research must come from the government, in place of private sources. The soundest policy the Foundation could adopt would be to guarantee that the schools will be left their present freedom to select and direct their research activities.

The Pollution Control Drive Is On

PUBLIC Law 845, passed by Congress in 1948 has provided the means for an attack on the water pollution problem along a wider front, and on more fronts, than was possible through state law alone. The new act authorizes comprehensive control programs, research, construction of waste treatment plants, and financial and technical aid to municipalities and industries as prescribed by law. The Public Health Service has already set up an ambitious program as administrator of the national features of the act.

Public Law 845 applies only to the pollution of surface and underground waters by either industrial waste or sewage. On another phase of the pollution problem, several hundred representatives of government and industry held a three day conference in Washington during May on the subject of air pollution from industries and other sources. In several communities air pollution is recognized as a problem of public concern.

Without question, the control of pollution of water and atmosphere, regardless as to the source of contamination, is a matter of growing public interest. Its concern to the refiner is wider than the means taken within his own plant to effectively dispose of the wastes created there. In each refining plant, no matter how small or where located, one staff man should be assigned the task of following all the developments, activities and discussions on pollution control in his area, reporting regularly to the management, for the sounder planning of company policies in this matter.

If You SULFONATE ...You've Got Problems

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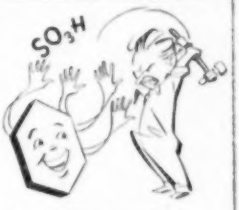
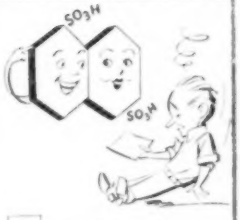
☐ Time-consuming stratification step.

☐ Solvent losses during extractions.

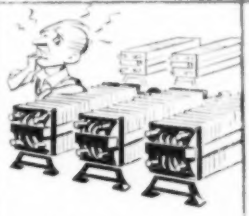
☐ Batches too small.



☐ Organics resist conventional sulfonations.



☐ Wrong isomers formed.



☐ Filtration of sulfate sludge.

☐ Spent acid disposal.

☐ Corrosion from by-product HCl.

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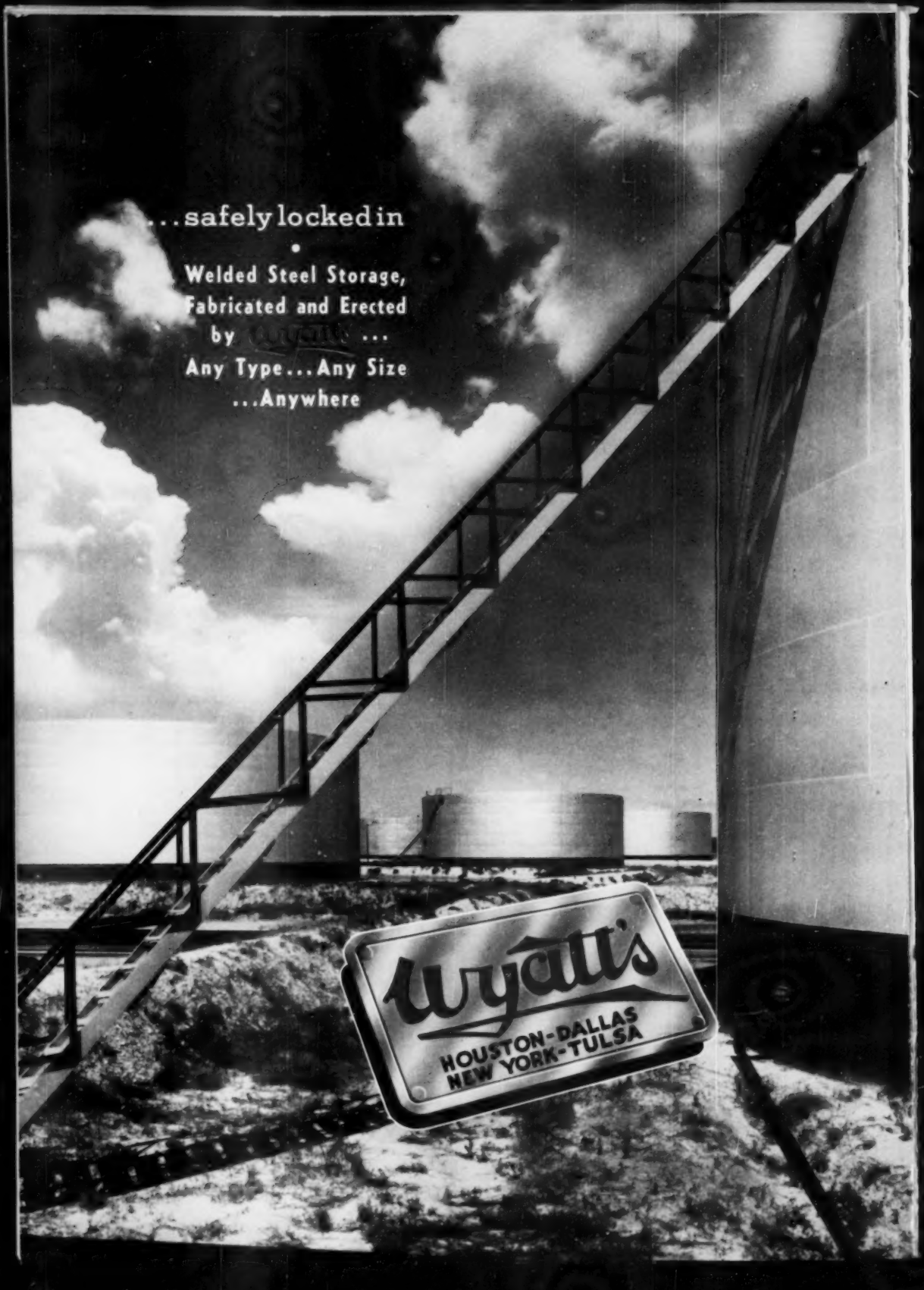
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